AN ESSAY ON CHIMNEY FIRE-PLACES,

WITH

Propoſals for Improving them, to ſave FUEL; to render Dwelling-houſes more COMFORTABLE and SALUBRIOUS, and effectually to prevent CHIMNIES from SMOKING.

VI

IV

AN

ESSAY

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WITH

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TO

SAVE FUEL;

To render DWELLING-HOUSES more
COMFORTABLE and SALUBRIOUS, and effectually to
PREVENT CHIMNIES FROM SMOKING.

ILLUSTRATED WITH ENGRAVINGS.

By BENJAMIN COUNT OF RUMFORD, F. R. S.
HONORARY MEMBER OF THE DUBLIN SOCIETY,
KNIGHT OF THE ORDER OF THE WHITE EAGLE,
Privy Counſellor of State, Lieutenant-General, &c, in the Service of his Moſt Serene Highneſs the ELECTOR-PALATINE, *Reigning* DUKE *of* BAVARIA.

THE THIRD EDITION, CORRECTED AND IMPROVED.

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TO THE HONOURABLE SOCIETY OF KING'S INNS.
1796

BRITISH MUSEUM
16 MAY 69

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TO THE

RIGHT HONOURABLE

JOHN FOSTER,

SPEAKER OF THE HOUSE OF COMMONS OF IRELAND,

THIS IMPROVED EDITION OF

COUNT RUMFORD's

VALUABLE AND INTERESTING

ESSAY ON CHIMNEY FIRE-PLACES,

IS MOST RESPECTFULLY INSCRIBED

BY HIS OBLIGED AND GRATEFUL SERVANTS,

RICH. EDW. MERCIER AND Co.

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ADVERTISEMENT.

THE Author thinks it his duty to explain the reaſons which have induced him to change the order in which the publication of his Eſſays has been announced to the Public.---Being ſuddenly called upon to ſend to Edinburgh a perſon acquainted with the method of altering Chimney Fire-places, which has lately been carried into execution in a number of houſes in London, in order to introduce theſe improvements in Scotland, he did not think it prudent to ſend any perſon on ſo important an errand without more ample inſtructions than could well be given verbally; and being obliged to write on the ſubject, he thought it beſt to inveſtigate the matter thoroughly, and to publiſh ſuch particular directions reſpecting the improvements in queſtion as may be ſufficient to enable all thoſe, who may be deſirous of adopting them, to make, or direct the neceſſary alterations in their Fire-places without any further aſſiſtance.

The following Letter, which the Author received from Sir John Sinclair, Baronet, Member of Parliament, and Preſident of the Board of Agriculture, will explain this matter more fully:

" You will hear with pleaſure that your mode
" of altering Chimnies, ſo as to prevent their
" ſmoking, to ſave fuel, and to augment heat,
" has anſwered not only with me, but with many
" of my friends who have tried it ; and that the
" Lord Provoſt and Magiſtrates of Edinburgh
" have voted a ſum of money to defray the expences
" of a bricklayer, who is to be ſent there
" for the purpoſe of eſtabliſhing the ſame plan in
" that city. I hope that you will have the goodneſs
" to expedite your paper upon the management
" of Heat, that the knowledge of ſo uſeful
" an art may be as rapidly and as extenſively diffuſed
" as poſſible.---With my beſt wiſhes for
" your ſucceſs in the various important purſuits
" in which you are now engaged, believe me,
" with great truth and regard,
" Your faithful and
" obedient ſervant,
" JOHN SINCLAIR."

Whitehall, London,
9th February, 1796

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CHIMNEY FIRE-PLACES.

CHAP. I.

Fire-places for burning Coals, or Wood, in an open Chimney, are capable of great Improvement.---Smoking Cbimnies may in all caſes be completely cured.---The immoderate Size of the Throats of Chimnies the principal Cauſe of all their Imperfections.---Philoſophical Inveſtigation of the Subject.---Remedies propoſed for all the Defects that have been diſcovered in Chimnies and their open Fire-places.---Theſe Remedies applicable to Chimnies deſtined for burning Wood, or Turf, as well as thoſe conſtructed for burning Coals.

THE plague of a ſmoky Chimney is proverbial; but there are many other very great defects in open Fire-places, as they are now commonly conſtructed in this Country, and indeed through Europe, which, being leſs obvious, are ſeldom attended to, and there are ſome of them very fatal in their conſequences to health; and I am perſuaded, coſt the lives of thouſands every year in this iſland.

Thoſe cold and chilling draughts of air on one ſide of the body, while the other ſide is ſcorched by a Chimney Fire, which every one who reads this muſt often have felt, cannot but be highly detrimental to health; and in weak and delicate conſtitutions muſt often produce the moſt fatal effects.---I have not a doubt in my own mind that thouſands die in this country every year of conſumptions occaſioned ſolely by this cauſe.---By a cauſe which might be ſo eaſily removed!---by a cauſe whoſe removal would tend to promote comfort and convenience in ſo many ways.

Strongly impreſſed as my mind is with the importance of this ſubject, it is not poſſible for me to remain ſilent.---The ſubject is too nearly connected with many of the moſt eſſential enjoyments of life not to be highly intereſting to all thoſe who feel pleaſure in promoting, or in contemplating the comfort and happineſs of mankind.---And without ſuffering myſelf to be deterred, either by the fear of being thought to give to the ſubject a degree of importance to which it is not entitled, or by the apprehenſion of being tireſome to my readers by the prolixity of my deſcriptions, I ſhall proceed to inveſtigate the ſubject in all its parts and details with the utmoſt care and attention.---And firſt with regard to ſmoking Chimnies:

There are various cauſes by which Chimnies may be prevented from carrying ſmoke; but there are none that may not eaſily be diſcovered and completely removed.---This will doubtleſs be conſidered as a bold aſſertion; but I truſt I ſhall be able to make it appear in a manner perfectly ſatisfactory to my readers that I have not

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ventured to give this opinion but upon good and ſufficient grounds.

Thoſe who will take the trouble to conſider the nature and properties of elaſtic fluids,---of air,---ſmoke---and vapour---and to examine the laws of their motions, and the neceſſary conſequences of their being rarefied by heat, will perceive that it would be as much a miracle if ſmoke ſhould not riſe in a Chimney, (all hindrances to its aſcent being removed,) as that water ſhould refuſe to run in a ſyphon, or to deſcend in a river.

The whole myſtery, therefore, of curing ſmoking Chimnies is compriſed in this ſimple direction,---*find out and remove thoſe local hindrances which forcibly prevent the ſmoke from following its natural tendency to go up the Chimney*; or rather, to ſpeak more accurately, which prevents its being forced up the Chimney by the preſſure of the heavier air of the room.

Although the cauſes, by which the aſſent of ſmoke in a Chimney *may be* obſtructed, are various, yet that cauſe which will moſt commonly, and I may ſay almoſt univerſally be found to operate, is one which is always very eaſy to diſcover, and as eaſy to remove,---the bad conſtruction of the Chimney *in the neighbourhood of the Fire-place*.

In the courſe of all my experience and practice in curing ſmoking Chimnies,--and I certainly have not had leſs than five hundred under my hands, and among them many which were thought to be quite incurable,---I have never been obliged, except in one ſingle inſtance, to have recourſe to any other method of cure than merely reducing the Fire-place and the throat of the Chimney, or that part of it which lies immediately above the Fire-place, to a proper form, and juſt dimenſions.

That my principles for conſtructing Fire-places are equally applicable to thoſe which are deſigned for burning coal, as to thoſe in which wood is burnt, has lately been abundantly proved by experiments made in London; for of above an hundred and fifty Fire-places which have been altered in that city, under my direction, within theſe laſt two months, there is not one which has not anſwered perfectly well *.---And by ſeveral experiments which have been made with great care, and with the aſſiſtance of thermometers, it has been demonſtrated, that the ſaving of fuel, ariſing from theſe improvements of Fire-places, amounts in all caſes to more than *half*, and in many caſes to more than *two thirds* of the quantity formerly conſumed. ---Now as the alterations in Fire-places which are neceſſary may be made at a very trifling expence, as any kind of grate or ſtove may be made uſe of, and as no iron work, but merely a few bricks and ſome mortar, or a few ſmall pieces of fireſtone, are required; the improvement in queſtion is very important, when conſidered merely with a view to economy; but it ſhould be remembered, that not only a great ſaving is made of fuel by the alterations propoſed, but that rooms are made much more comfortable and more ſalubrious;---that they may be more equally warmed, and more eaſily kept at any required temperature;---that all draughts of cold air from the doors and windows towards the Fire-place, which are ſo fatal to delicate conſtitutions, will be completely prevented; that in conſequence of the air being equally warm all over the room, or in all parts of it, it may be entirely changed with the greateſt facility, and the room completely ventilated, when this air is become unfit for reſpiration, and this merely by throwing open for a moment a door opening into ſome paſſage from whence freſh air may be had, and the upper part of a window; or by opening the upper part of one window and the lower part of another. And as the operation of ventilating the room, even when it is done in the moſt complete manner, will never require the door and window to be open more than one minute; in this ſhort time the walls of the room will not be ſenſibly cooled, and the freſh air which comes into the room will, in a very few minutes, be ſo completely warmed by theſe walls, that the temperature of the room, though the air in it be perfectly changed, will be brought to be very nearly the ſame as it was before the ventilation.

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* Eves and Sutton, bricklayers, Broad Sanctuary, Weſtminſter, have alone altered above 90 Chimnies.—The experiment was firſt made in London at Lord Palmerſton's houſe in Hanover-ſquare;—then two Chimnies were altered in the houſe of Sir John Sinclair, Baronet, Preſident of the Board of Agriculture; one in the room in which the Board meets, and the other in the Secretary's room; which laſt being much frequented by perſons from all parts of Great Britain, it was hoped that circumſtance would tend much to expedite the introduction of theſe improvements in various parts of the kingdom. Several Chimnies were then altered in the houſe of Sir Joſeph Banks, Baronet, K. B. Preſident of the Royal Society. Afterwards a number were altered in Devonſhire-houſe;—in the houſe of Earl Beſborough, in Cavendiſh-ſquare, and at his ſeat at Roehampton;—at Holywell-houſe, near St. Alban's, the ſeat of the Counteſs Dowager of Spencer; at Melbourne-houſe;—at Lady Templeton's, in Portland-place;—at Mrs. Montagu's, in Portman-ſquare;—at Lord Sudley's, in Dover-ſtreet;—at the Marquis of Saliſbury's ſeat at Hatfield, and at his houſe in town;—at Lord Palmerſton's ſeat at Broadlands, near Southampton, and at ſeveral gentlemen's houſes in that neighbourhood;—and a great many others: but it would be tireſome to enumerate them all; and even theſe are mentioned merely for the ſatisfaction of thoſe who may wiſh to make inquiries reſpecting the ſucceſs of the experiments.

Thoſe who are acquainted with the principles of pneumatics, and know why the warm air in a room ruſhes out at an opening made for it at the top of a window when colder air from without is permitted to enter by the door, or by any other opening ſituated lower than the firſt, will ſee, that it would be quite impoſſible to ventilate a room in the complete and expeditious manner here deſcribed, where the air in a room is partially warmed, or hardly warmed at all, and where the walls of the room, remote from the fire, are conſtantly cold; which muſt always be the caſe where, in conſequence of a ſtrong current up the Chimney, ſtreams of cold air are continually coming in through all the crevices of the doors and windows, and flowing into the Fire-place.

But although rooms, furniſhed with Fire-places conſtructed upon the principles here recommended, may be eaſily and moſt effectually ventilated, (and this is certainly a circumſtance in favour of the propoſed improvements,) yet ſuch total ventilations will very ſeldom, if ever, be neceſſary.---As long as *any fire* is kept up in the room, there is ſo conſiderable a current of air up that Chimney, notwithſtanding all the reduction that can be made in the ſize of its throat, that the continual change of air in the room which this current occaſions will generally be found to be quite ſufficient for keeping the air in the room ſweet and wholeſome; and indeed in rooms in which there is no open Fire-place, and conſequently no current of air from the room ſetting up the Chimney, which is the caſe in Germany, and all the northern parts of Europe, where rooms are heated by ſtoves, whoſe Fire-places opening without are not ſupplied with the air neceſſary for the combuſtion of the fuel from the room;---and although, in moſt of the rooms abroad, which are ſo heated, the windows and doors are double, and both are cloſed in the moſt exact manner poſſible, by ſlips of paper paſted over the crevices, or by ſlips of liſt or fur; yet when theſe rooms are tolerably large, and when they are not very much crowded by company, nor filled with a great many burning lamps or candles, the air in them is ſeldom ſo much injured as to become oppreſſive or unwholeſome; and thoſe who inhabit them ſhew by their ruddy countenances, as well as by every other ſign of perfect health, that they ſuffer no inconvenience whatever from their cloſeneſs. There is frequently, it is true, an oppreſſiveneſs in the air of a room heated by a German ſtove, of which thoſe who are not much accuſtomed to living in thoſe rooms ſeldom fail to complain, and indeed with much reaſon; but this oppreſſiveneſs does not ariſe from the air of the room being injured by the reſpiration and perſpiration of thoſe who inhabit it;---it ariſes from a very different cauſe;---from a fault in the conſtruction of German ſtoves in general, but which may be eaſily and moſt completely remedied, as I ſhall ſhow more fully in another place. In the mean time I would juſt obſerve here with regard to theſe ſtoves, that as they are often made of iron, and as this metal is a very good conductor of heat, ſome part of the ſtove in contact with the air of the room becomes ſo hot as to calcine, or rather to *roaſt* the duſt which lights upon it; which never can fail to produce a diſagreeable effect on the air of the room. And even when the ſtove is conſtructed of pantiles or pottery-ware, if any part of it in contact with the air of the room is ſuffered to become very hot, which ſeldom fails to be the caſe in German ſtoves conſtructed on the common principles, nearly the ſame effects will be found to be produced on the air as when the ſtove is made of iron, as I have very frequently had occaſion to obſerve.

Though a room be cloſed in the moſt perfect manner poſſible, yet, as the quantity of air injured and rendered unfit for further uſe by the reſpiration of two or three perſons in a few hours is very ſmall, compared to the immenſe volume of air which a room of a moderate ſize contains; and as a large quantity of freſh air always enters the room, and an equal quantity of the warm air of the room is driven out of it every time the door is opened, there is much leſs danger of the air or the room becoming unwholeſome for the want of ventilation than has been generally imagined; particularly in cold weather, when all the different cauſes which conſpire to change the air of warmed rooms act with increaſed power and effect.

Thoſe who have any doubts reſpecting the very great change of air or ventilation which takes place each time the door of a warm room is opened in cold weather, need only ſet the door of ſuch a room wide open for a moment, and hold two lighted candles in the door-way, one near the top of the door, and the other near the bottom of it; the violence with which the flame of that above will be driven outwards, and that below inwards, by the two ſtrong currents of air which, paſſing in oppoſite directions, ruſh in and out of the room at the ſame time, will be convinced that the change of air which actually takes place muſt be very conſiderable indeed; and theſe currents will be ſtronger, and conſequently the change of air greater, in proportion as the difference is greater between the temperatures of the air within the room and of that without. I have been more particular upon this ſubject,---the ventilation of warmed rooms which are conſtantly inhabited,---as I know that people in general in this country have great apprehenſions of the bad conſequences to health of living in rooms in which there is not a continual influx of cold air from without. I am as much an advocate for a *free circulation* of air as any body, and always ſleep in a bed without curtains on that account; but I am much inclined to think, that the currents of cold air which never fail to be produced in rooms heated by Fire-places conſtructed upon the common principle,---thoſe partial heats on one ſide of the body, and cold blaſts on the other, ſo often felt in houſes in this country, are infinitely more detrimental to health than the ſuppoſed cloſeneſs of the air in a room warmed more equally, and by a ſmaller fire.

All theſe advantages, attending the introduction of the improvements in Fire-places here recommended, are certainly important, and I do not know that they are counterbalanced by any one diſadvantage whatſoever. The only complaint that I have ever heard made againſt them was, that they made the rooms *too* warm; but the remedy to this evil is ſo perfectly ſimple and obvious, that I ſhould be almoſt afraid to mention it, leſt it might be conſidered as an inſult to the underſtanding of the perſon to whom ſuch information ſhould be given; for nothing ſurely can be conceived more perfectly ridiculous than the embarraſſment of a perſon on account of the too great heat of his room, when it is in his power to diminiſh *at pleaſure* the fire by which it is warmed;

and

and yet, ſtrange as it may appear, this has ſometimes happened.

Before I proceed to give directions for the conſtruction of Fire-places, it will be proper to examine more carefully the Fire-places now in common uſe;---to point out their faults;---and to eſtabliſh the principles upon which Fire-places ought to be conſtructed.

The great fault of all the open Fire-places, or Chimnies, for burning wood or coals in an open fire, now in common uſe, is, that they are much too large; or rather it is *the throat of the Chimney*, or the lower part of its open canal, in the neighbourhood of the mantle, and immediately over the fire, which is too large. This opening has hitherto been left larger than otherwiſe it probably would have been made, in order to give a paſſage to the Chimney-ſweeper; but I ſhall ſhow hereafter how a paſſage for the Chimney-ſweeper may be contrived without leaving the throat of the Chimney of ſuch enormous dimenſions as to ſwallow up and devour all the warm air of the room, inſtead of merely giving a paſſage to the ſmoke and heated vapour which ariſe from the fire; for which laſt purpoſe alone it ought to be deſtined.

Were it my intention to treat my ſubject in a formal ſcientific manner, it would doubtleſs be proper, and even neceſſary, to begin by explaining in the fulleſt manner, and upon the principles founded on the laws of nature, relative to the motions of elaſtic fluids, as far as they have been diſcovered and demonſtrated, the cauſes of the aſcent of ſmoke; and alſo to explain and illuſtrate upon the ſame principles, and even to meaſure, or eſtimate by calculations, the preciſe effects of all thoſe mechanical aids which may be propoſed for aſſiſting it in its aſcent, or rather for removing thoſe obſtacles which hinder its motion upwards ;---but as it is my wiſh rather to write an uſeful practical treatiſe, than a learned diſſertation, being more deſirous to contribute in diffuſing uſeful knowledge, by which the comforts and enjoyments of mankind may be encreaſed, than to acquire the reputation of a philoſopher among learned men, I ſhall endeavour to write in ſuch a manner as to be eaſily underſtood *by thoſe who are moſt likely to profit by the information I have to communicate*, and conſequently moſt likely to aſſiſt in bringing into general uſe the improvements I recommend. This being premiſed, I ſhall proceed, without any further preface or introduction, to the inveſtigation of the ſubject I have undertaken to treat.

As the immoderate ſize of the throats of Chimnies is the great fault of their conſtruction, it is this fault which ought always to be firſt attended to in every attempt which is made to improve them ; for however perfect the conſtruction of a Fire-place may be in other reſpects, if the opening left for the paſſage of the ſmoke is larger than is neceſſary for that purpoſe, nothing can prevent the warm air of the room from eſcaping through it ; and whenever this happens, there is not only an unneceſſary loſs of heat, but the warm air which leaves the room to go up the chimney being replaced by cold air from without, the draughts of cold air, ſo often mentioned, cannot fail to be produced in the room, to the great annoyance of thoſe who inhabit it. But although both theſe evils may be effectually remedied by reducing the throat of the Chimney to a proper ſize, yet in doing this ſeveral precautions will be neceſſary.

and yet, ſtrange as it may appear, this has ſometimes happened.

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The great fault of all the open Fire-places, or Chimnies, for burning wood or coals in an open fire, now in common uſe, is, that they are much too large; or rather it is *the throat of the Chimney*, or the lower part of its open canal, in the neighbourhood of the mantle, and immediately over the fire, which is too large. This opening has hitherto been left larger than otherwiſe it probably would have been made, in order to give a paſſage to the Chimney-ſweeper; but I ſhall ſhow hereafter how a paſſage for the Chimney-ſweeper may be contrived without leaving the throat of the Chimney of ſuch enormous dimenſions as to ſwallow up and devour all the warm air of the room, inſtead of merely giving a paſſage to the ſmoke and heated vapour which ariſe from the fire; for which laſt purpoſe alone it ought to be deſtined.

Were it my intention to treat my ſubject in a formal ſcientific manner, it would doubtleſs be proper, and even neceſſary, to begin by explaining in the fulleſt manner, and upon the principles founded on the laws of nature, relative to the motions of elaſtic fluids, as far as they have been diſcovered and demonſtrated, the cauſes of the aſcent of ſmoke; and alſo to explain and illuſtrate upon the ſame principles, and even to meaſure, or eſtimate by calculations, the preciſe effects of all thoſe mechanical aids which may be propoſed for aſſiſting it in its aſcent, or rather for removing thoſe obſtacles which hinder its motion upwards ;---but as it is my wiſh rather to write an uſeful practical treatiſe, than a learned diſſertation, being more deſirous to contribute in diffuſing uſeful knowledge, by which the comforts and enjoyments of mankind may be encreaſed, than to acquire the reputation of a philoſopher among learned men, I ſhall endeavour to write in ſuch a manner as to be eaſily underſtood *by thoſe who are moſt likely to profit by the information I have to communicate*, and conſequently moſt likely to aſſiſt in bringing into general uſe the improvements I recommend. This being premiſed, I ſhall proceed, without any further preface or introduction, to the inveſtigation of the ſubject I have undertaken to treat.

As the immoderate ſize of the throats of Chimnies is the great fault of their conſtruction, it is this fault which ought always to be firſt attended to in every attempt which is made to improve them ; for however perfect the conſtruction of a Fire-place may be in other reſpects, if the opening left for the paſſage of the ſmoke is larger than is neceſſary for that purpoſe, nothing can prevent the warm air of the room from eſcaping through it ; and whenever this happens, there is not only an unneceſſary loſs of heat, but the warm air which leaves the room to go up the chimney being replaced by cold air from without, the draughts of cold air, ſo often mentioned, cannot fail to be produced in the room, to the great annoyance of thoſe who inhabit it. But although both theſe evils may be effectually remedied by reducing the throat of the Chimney to a proper ſize, yet in doing this ſeveral precautions will be neceſſary. And firſt of all, the throat of the Chimney ſhould be in its proper place; that is to ſay, in that place in which it ought to be, in order that the aſcent of the ſmoke may be moſt facilitated; for every means which can be employed for facilitating the aſcent of the ſmoke in the Chimney, muſt naturally tend to prevent the Chimney from ſmoking: now as the ſmoke and hot vapour which riſe from a fire naturally tend *upwards*, the proper place for the throat of the Chimney is evidently perpendicularly *over the fire.*

But there is another circumſtance to be attended to in determining the proper place for the throat of a Chimney, and that is, to aſcertain its diſtance from the fire, or *how far* above the burning fuel it ought to be placed. In determining this point, there are many things to be conſidered, and ſeveral advantages and diſadvantages to be weighed and balanced.

As the ſmoke and vapour which aſcend from burning fuel riſe in conſequence of their being rarefied by heat, and made lighter than the air of the ſurrounding atmoſphere; and as the degree of their rarefaction, and conſequently their tendency to riſe, is in proportion to the intenſity of their heat; and further, as they are hotter near the fire than at a greater diſtance from it, it is clear that the nearer the throat of the Chimney is to the fire, the ſtronger will be what is commonly called, its *draught*, and the leſs danger there will be of its ſmoking. But on the other hand, when the draught of the Chimney is very ſtrong, and particularly when this ſtrong draught is occaſioned by the throat of the Chimney being very near the fire, it may ſo happen that the draught of air into the fire may become ſo ſtrong, as to cauſe the fuel to be conſumed too rapidly. There are likewiſe ſeveral other inconveniencies which would attend the placing of the throat of a Chimney *very near* the burning fuel.

In introducing the improvement propoſed, in Chimnies already built, there can be no queſtion in regard to the height of the throat of the Chimney, for its place will be determined by the height of the mantle. It can hardly be made lower than the mantle; and it ought always to be brought down as nearly upon the level with the bottom of it as poſſible. If the Chimney is apt to ſmoke, it will ſometimes be neceſſary either to lower the mantle or to diminiſh the height of the opening of the Fire-place by throwing over a flat arch, or putting in a ſtraight piece of ſtone from one ſide of it to the other, or which will be ſtill more ſimple and eaſy in practice, building a wall of bricks, ſupported by a flat bar of iron, immediately under the mantle.

Nothing is ſo effectual to prevent Chimnies from ſmoking as diminiſhing the opening of the Fire-place in the manner here deſcribed, and lowering and diminiſhing the throat of the Chimney; and I have always found, except in the ſingle inſtance already mentioned, that a perfect cure may be effected by *theſe means alone* even in the moſt deſperate caſes. It is true, that when the conſtruction of the Chimney is very bad indeed, or its ſituation very unfavourable to the aſcent of the ſmoke, and eſpecially when both theſe diſadvantages exiſt at the ſame time, it may ſometimes be neceſſary to diminiſh the opening of the Fire-place, and particularly to lower it, and alſo to lower the throat of the Chimney, more than might be wiſhed: but ſtill I think this can produce no inconvenience to be compared with that greateſt of all plagues, a ſmoking Chimney.

The poſition of the throat of a Chimney being determined, the next points to be aſcertained are its ſize and form, and the manner in which it ought to be connected with the Fire-place below, and with the open canal of the Chimney above.

But as theſe inveſtigations are intimately connected with thoſe which relate to the form proper to be given to the Fire-place itſelf, we muſt conſider them all together.

That theſe inquiries may be purſued with due method, and that the concluſions drawn from them may be clear and ſatisfactory, it will be neceſſary to conſider, firſt, what the objects are which ought principally to be had in view in the conſtruction of a Fire-place; and ſecondly, to ſee how theſe objects can beſt be attained.

Now the deſign of a Chimney Fire being ſimply to warm a room, it is neceſſary, firſt of all, to contrive matters ſo that the room ſhall be actually warmed; ſecondly, that it be warmed with the ſmalleſt expence of fuel poſſible; and, thirdly, that in warming it, the air of the room be preſerved perfectly pure, and fit for reſpiration, and free from ſmoke and all diſagreeable ſmells.

In order to take meaſures with certainty for warming a room by means of an open Chimney Fire, it will be neceſſary to conſider *how*, or in *what manner*, ſuch a fire communicates heat to a room. This queſtion may perhaps, at the firſt view of it, appear to be ſuperfluous and trifling, but a more careful examination of the matter will ſhow it to be highly deſerving of the moſt attentive inveſtigation.

To determine in what manner a room is heated by an open Chimney Fire, it will be neceſſary firſt of all to find out, *under what form* the heat generated in the combuſtion of the fuel exiſts, and then to ſee how it is communicated to thoſe bodies which are heated by it.

In regard to the firſt of theſe ſubjects of inquiry, it is quite certain that the heat which is generated in the combuſtion of the fuel exiſts under *two* perfectly diſtinct and very different forms. One part of it is *combined* with the ſmoke, vapour and heated air which ariſe from the burning fuel, and goes off with them into the upper regions of the atmoſphere; while the other part, which appears to be *uncombined*, or, as ſome ingenious philoſophers have ſuppoſed, combined only with light, is ſent off from the fire in rays in all poſſible directions.

With reſpect to the ſecond ſubject of inquiry; namely, how this heat, exiſting under theſe two different forms, is communicated to other bodies; it is highly probable that the combined heat can only be communicated to other bodies by *actual contact* with the body with which it is combined; and with regard to the rays which are ſent off by burning fuel, it is certain that *they* communicate or generate heat only *when* and *where* they are ſtopped or abſorbed. In paſſing through air, which is tranſparent, they certainly do not communicate any heat to it; and it ſeems highly probable that they do not communicate heat to ſolid bodies by which they are reflected.

In theſe reſpects they ſeem to bear a great reſemblance to the ſolar rays. But in order not to diſtract the attention of my reader, or carry him too far away from the ſubject more immediately under conſideration, I muſt not enter too deeply into theſe inquiries reſpecting the nature and properties of what has been called *radiant heat*. It is certainly a moſt curious ſubject of philoſophical inveſtigation, but more time would be required to do it juſtice than we now have to ſpare. We muſt therefore content ourſelves with ſuch a partial examination of it as will be ſufficient for our preſent purpoſe.

A queſtion which naturally preſents itſelf here is, What proportion does the radiant heat bear to the combined heat?---Though that point has not yet been determined with any conſiderable degree of preciſion, it is, however, quite certain, that the quantity of heat which goes off combined with the ſmoke, vapour and heated air is much more conſiderable, perhaps three or four times greater at leaſt, than that which is ſent off from the fire in rays.---And yet, ſmall as the quantity is of this radiant heat, it is the only part of the heat generated in the combuſtion of fuel burnt in an open Fire-place which is ever employed, or which can ever be employed, in heating a room.

The whole of the combined heat eſcapes by the Chimney, and is totally loſt; and, indeed, no part of it could ever be brought into a room from an open Fire-place, without bringing along with it the ſmoke with which it is combined; which, of courſe, would render it impoſſible for the room to be inhabited. There is, however, one method by which combined heat, and even that which ariſes from an open Fire-place, may be made to aſſiſt in warming a room; and that is by making it paſs through ſomething analogous to a German ſtove, placed in the Chimney above the fire.--- But of this contrivanee I ſhall take occaſion to treat more fully hereafter: in the mean time I ſhall continue to inveſtigate the properties of open Chimney Fire-places, conſtructed upon the moſt ſimple principles, ſuch as are now in common uſe; and ſhall endeavour to point out and explain all thoſe improvements of which *they* appear to me to be capable. When fuel is burnt in Fire-places upon this ſimple conſtruction, where the ſmoke eſcapes immediately by the open canal of the Chimney, it is quite evident that all the combined heat muſt of neceſſity be loſt; and as it is the radiant heat alone which can be employed in heating a room, it becomes an object of much importance to determine how the greateſt quantity of it may be generated in the combuſtion of the fuel, and how the greateſt proportion poſſible of that generated may be brought into the room.

Now the quantity of radiant heat generated in the combuſtion of a given quantity of any kind of fuel depends very much upon the management of the fire, or upon the manner in which the fuel is conſumed. When the fire burns bright, much radiant heat will be ſent off from it; but when it is *ſmothered up*, very little will be generated; and indeed very little combined heat, that can be employed to any uſeful purpoſe: moſt of the heat produced will be immediately *expended* in giving elaſticity to a thick denſe vapour or ſmoke which will be ſeen riſing from the fire;--- and the combuſtion being very incomplete, a great part of the inflammable matter of the fuel being merely rarefied and driven up the Chimney without being inflamed, the fuel will be waſted to little purpoſe. And hence it appears of how much importance it is, whether it be conſidered with a view to economy, or to cleanlineſs, comfort and elegance, to pay due attention to the management of a Chimney Fire.

Nothing can be more perfectly void of common ſenſe, and waſteful and ſlovenly at the ſame time, than the manner in which Chimney Fires, and particularly where coals are burned, are commonly managed by ſervants. They throw on a load of coals at once, through which the flame is hours in making its way; and frequently it is not without much trouble that the fire is prevented from going quite out. During this time no heat is communicated to the room; and what is ſtill worſe, the throat of the Chimney being occupied merely by a heavy denſe vapour, not poſſeſſed of any conſiderable degree of heat, and conſequently not having much elaſticity, the warm air of the room finds leſs difficulty in forcing its way up the Chimney and eſcaping, than when the fire burns bright;---but it happens not unfrequently, eſpecially in Chimnies and Fire-places ill conſtructed, that this current of warm air from the room which preſſes into the Chimney, croſſing upon the current of heavy ſmoke which ariſes ſlowly from the fire, obſtructs it in its aſcent, and beats it back into the room; hence it is that Chimnies ſo often ſmoke when too large a quantity of freſh coals is put upon the fire. So many coals ſhould never be put on the fire at once as to prevent the free paſſage of the flame between them. In ſhort, a fire ſhould never be ſmothered; and when proper attention is paid to the quantity of coals put on, there will be very little uſe for the poker; and this circumſtance will contribute very much to cleanlineſs, and to the preſervation of furniture.

Thoſe who have feeling enough to be made miſerable by any thing careleſs, ſlovenly, and waſteful which happens under their eyes,---who know what comfort is, and conſequently are worthy of the enjoyments of a *clean hearth* and a *cheerful fire*, ſhould really either take the trouble themſelves to manage their fires, (which, indeed, would rather be an amuſement to them than a trouble,) or they ſhould inſtruct their ſervants to manage them better.

But to return to the ſubject more immediately under conſideration. As we have ſeen what is neceſſary to the production or generation of radiant heat, it remains to determine how the greateſt proportion of that generated and ſent off from the fire in all directions may be made to enter the room, and aſſiſt in warming it. Now as the rays which are thrown off from burning fuel have this property in common with light, that they generate heat only *when* and *where* they are ſtopped or abſorbed, and alſo in being capable of being reflected *without generating heat* at the ſurfaces of various bodies, the knowledge of theſe properties will enable us to take meaſures, with the utmoſt certainty, for producing the effect required,---that is to ſay, for bringing as much radiant heat as poſſible into the room.

This muſt be done, firſt, by cauſing as many as poſſible of the rays, as they are ſent off from the fire in ſtraight lines, to come *directly* into the room; which can only be effected by bringing the fire as far forward as poſſible, and leaving the open of the Fire-place as wide and as high as can be done without inconvenience; and ſecondly, by making the ſides and back of the Fire-place of ſuch form, and conſtructing them of ſuch materials, as to cauſe the direct rays from the fire, which ſtrike againſt them, to be ſent into the room *by reflection* in the greateſt abundance.

Now it will be found, upon examination, that the beſt form for the vertical ſides of a Fire-place, or the *covings*, (as they are called,) is that of an upright plane, making an angle with the plane of the back of the Fire-place, of about 135 degrees.------According to the preſent conſtruction of Chimnies this angle is 90 degrees, or forms a right angle; but as in this caſe the two ſides or covings of the Fire place (AC, BD, Fig. 1.) are parallel to each other, it is evident that they are very ill contrived for throwing into the room by reflection the rays from the fire which fall on them.

To have a clear and perfect idea of the alterations I propoſe in the forms of Fire-places, the reader need only to obſerve, that whereas the backs of Fire-places, as they are now commonly conſtructed, are as wide as the opening of the Fire-place in front, and the ſides of it are of courſe perpendicular to it, and parallel to each other,---in the Fire-places I recommend, the back (*i k*, Fig. 3.) is about one-third of the width of the opening of the Fire-place in front *(a b)*, and conſequently that the two ſides or covings of the Fire-place *(a i* and *b k)*, inſtead of being perpendicular to the back, are inclined to it at the angle of about 135 degrees; and in conſequence of this poſition, inſtead of being parallel to each other, each of them preſents an oblique front towards the opening of the Chimney, by means of which the rays which they reflect are thrown into the room. A bare inſpection of the annexed drawings (Fig. 1. and Fig. 3.) will render this matter perfectly clear and intelligible.

In regard to the materials which it will be moſt advantageous to employ in the conſtruction of Fire-places, ſo much light has, I flatter myſelf, already been thrown on the ſubject we are inveſtigating, and the principles adopted have been eſtabliſhed on ſuch clear and obvious facts, that no great difficulty will attend the determination of that point.- -As the object in view is to bring radiant heat into the room, it is clear that that material is the beſt for the conſtruction of a Fire-place which reflects the moſt, or which *abſorbs the leaſt* of it; for that heat which is *abſorbed* cannot be *reflected*.---Now as bodies which abſorb radiant heat are neceſſarily heated in conſequence of that abſorption, to diſcover which of the various materials that can be employed for conſtructing Fire-places are beſt adapted for that purpoſe, we have only to find out by an experiment, very eaſy to be made, what bodies acquire *leaſt heat* when expoſed to the direct rays of a clear fire;---for thoſe which are leaſt heated, evidently abſorb the leaſt, and conſequently reflect the moſt radiant heat. And hence it appears that iron, and in general, metals of all kinds, which are well known to *grow very hot* when expoſed to the rays projected by burning fuel, are to be reckoned among the *very worſt* materials that it is poſſible to employ in the conſtruction of Fire-places.

The beſt materials I have hitherto been able to diſcover are fire-ſtone, and common bricks and mortar. Both theſe materials are, fortunately, very cheap; and as to their comparative merits, I hardly know to which of them the preference ought to be given.

When bricks are uſed they ſhould be covered with a thin coating of plaſter, which, when it is become perfectly dry, ſhould be white-waſhed. The fire-ſtone ſhould likewiſe be white-waſhed, when that is uſed; and every part of the Fire-place, which is not expoſed to being ſoiled and made black by the ſmoke, ſhould be kept as white and clean as poſſible. As *white* reflects more heat, as well as more light than any other colour, it ought always to be preferred for the inſide of a Chimney Fire-place, and *black*, which reflects neither light nor heat, ſhould be moſt avoided.

I am well aware how much the opinion I have here ventured to give, reſpecting the unfitneſs of iron and other metals to be employed in the conſtruction of open Fire-places, differs from the opinion generally received upon that ſubject; ---and I even know that the very reaſon which, according to my ideas of the matter, renders them totally unfit for the purpoſe, is commonly aſſigned for making uſe of them, namely, that they ſoon grow very hot. But I would beg leave to aſk what advantage is derived from heating them?

I have ſhewn the diſadvantage of it, namely, that the quantity of radiant heat thrown into the room is diminiſhed; and it is eaſy to ſhow that almoſt the whole of that abſorbed by the metal is ultimately carried up the Chimney by the air, which, coming into contact with this hot metal, is heated and rarefied by it, and forcing its way upwards, goes of with the ſmoke; and as no current of air ever ſets from any part of the opening of a Fire-place into the room, it is impoſſible to conceive how the heat exiſting in the metal compoſing any part of the apparatus of the Fire-place and ſituated within its cavity, can come, or be brought into the room.

This difficulty may be in part removed, by ſuppoſing, what indeed ſeems to be true in a certain degree, that the heated metal ſends off in rays, the heat it acquires from the fire, even when it is not heated red hot; but ſtill, as it never can be admitted that the heat abſorbed by the metal and afterwards thrown off by it in rays, is *increaſed* by this operation, nothing can be gained by it; and as much muſt neceſſarily be loſt in conſequence of the great quantity of heat communicated by the hot metal to the air in contact with it, which, as has already been ſhewn, always makes its way up the Chimney, and flies off into the atmoſphere, the loſs of heat attending the uſe of it is too evident to require being farther inſiſted on.

There is however, in Chimney Fire-places deſtined for burning coals, one eſſential part, the grate, which cannot well be made of any thing elſe but iron; but there is no neceſſity whatever for that immenſe quantity of iron which ſurrounds grates as they are now commonly conſtructed and fitted up, and which not only renders them very expenſive, but injures very eſſentially the Fire-place. If it ſhould be neceſſary to diminiſh the opening of a large Chimney in order to prevent its ſmoking, it is much more ſimple, œconomical, and better in all reſpects, to do this with marble, fire-ſtone, or even with bricks and mortar, than to make uſe of iron, which, as has already been ſhewn, is the very worſt material that can poſſibly be employed for that purpoſe; and as to regiſters, they not only are quite unneceſſary, where the throat of a Chimney is properly conſtructed, and of proper dimenſions, but in that caſe would do much harm. If they act at all, it muſt be by oppoſing their flat ſurfaces to the current of riſing ſmoke in a manner which cannot fail to embarraſs and impede its motion. But we have ſhown that the paſſage of the ſmoke through the throat of a Chimney ought to be facilitated as much as poſſible, in order that it may be enabled to paſs by a ſmall aperture.

Regiſter-ſtoves have often been found to be of uſe, but it is becauſe the great fault of all Fireplaces conſtructed upon the common principles being the enormous dimenſions of the throat of the Chimney, this fault has been in ſome meaſure corrected by them; but I will venture to affirm, that there never was a Fire-place ſo corrected that would not have been much more improved, and with infinitely leſs expence, by the alterations here recommended, and which will be more particularly explained in the next Chapter.

CHAP.

CHAP. II.

Practical Directions deſigned for the Uſe of Workmen, ſhewing how they are to proceed in making the Alterations neceſſary to improve Chimney Fire-places, and effectually to cure ſmoking Chimneys.

ALL Chimney Fire-places, without exception, whether they are deſigned for burning wood or coals, and even thoſe which do not ſmoke, as well as thoſe which do, may be greatly improved by making the alterations in them here recommended; for it is by no means *merely* to prevent Chimnies from ſmoking that theſe improvements are recommended, but it is alſo to make them better in all other reſpects as Fire-places; and when the alterations propoſed are properly executed, which may very eaſily be done with the aſſiſtance of the following plain and ſimple directions, the Chimnies will never fail to anſwer, I will venture to ſay, even beyond expectation. The room will be heated much more equally and more pleaſantly with *leſs than half the fuel* uſed before, the fire will be more cheerful and more agreeable; and the general appearance of the Fire-place more neat and elegant, and the Chimney *will never ſmoke*.

The advantages which are derived from mechanical inventions and contrivances are, I know, frequently accompanied by diſadvantages which it is not always poſſible to avoid; but in the caſe in queſtion, I can ſay with truth, that I know of no diſadvantage whatever that attends the Fire-places conſtructed upon the principles here recommended.---But to proceed in giving directions for the conſtruction of theſe Fire-places.

That what I have to offer on this ſubject may be the more eaſily underſtood, it will be proper to begin by explaining the preciſe meaning of all thoſe technical words and expreſſions which I may find it neceſſary or convenient to uſe.

By the *throat* of a Chimney, I mean the lower extremity of its canal, where it unites with the upper part of its open Fire-place.---This throat is commonly found about a foot above the level of the lower part of the mantle, and it is ſometimes contracted to a ſmaller ſize than the reſt of the canal of the Chimney, and ſometimes not.

Fig. 5, ſhows the ſection of a Chimney on the common conſtruction, in which *d e* is the throat.

Fig. 6, ſhows the ſection of the Chimney altered and improved, in which *d i* is the reduced throat.

The *breaſt* of a Chimney is the part of it which is immediately behind the mantle.---It is the wall which forms the entrance from below into the throat of the Chimney in front, or towards the room.---It is oppoſite to the upper extremity of the back of the open Fire-place, and parallel to it;---in ſhort it may be ſaid to be the back part of the mantle itſelf.---In the figures 5 and 6, it is marked by the letter *d*. The *width* of the throat of Chimney (*d e* fig. 5. and *d i* fig. 6,) is taken from the breaſt of the Chimney to the back, and its *length* is taken at right angles to its width, or in a line parallel to the mantle (*a* fig. 5 and 6.)

Before I proceed to give particular directions reſpecting the exact forms and dimenſions of the different parts of a Fire-place, it may be uſeful to make ſuch general and practical obſervations upon the ſubject as can be clearly underſtood without the aſſiſtance of drawings; for the more complete the knowledge of any ſubject is which can be acquired without drawings, the more eaſily will it be to underſtand the drawings when it becomes neceſſary to have recourſe to them.

The bringing forward the fire into the room, or rather bringing it nearer to the front of the opening of the Fire-place;---and the diminiſhing of the throat of the Chimney, being two objects principally had in view in the alterations in Fire-places here recommended, it is evident that both theſe may be attained merely by bringing forward the back of the Chimney.---The only queſtion therefore is, how far it ſhould be brought forward?---The anſwer is ſhort, and eaſy to be underſtood;---bring it forward as far as poſſible, without diminiſhing too much the paſſage which muſt be left for the ſmoke. Now as this paſſage, which, in its narroweſt part, I have called the *throat of the Chimney*, ought, for reaſons which are fully explained in the foregoing Chapter, to be immediately, or perpendicularly over the Fire, it is evident that the back of the Chimney muſt always be built perfectly upright.---To determine therefore the place for the new back, or how far preciſely it ought to be brought forward, nothing more is neceſſary than to aſcertain how wide the throat of the Chimney ought to be left, or what ſpace muſt be left, between the top of the breaſt of the Chimney, where the upright canal of the Chimney begins, and the new back of the Fire-place carried up perpendicularly to that height.

In the courſe of my numerous experiments upon Chimnies I have taken much pains to determine the width proper to be given to this paſſage, and I have found, that, when the back of the Fire-place is of a proper width, the beſt width for the throat of a Chimney, when the Chimney and the Fire-place are at the uſual form and ſize, is *four inches*.—Three inches might ſometimes anſwer, eſpecially where the Fire-place is very ſmall, and the Chimney good, and well ſituated; but as it is always of much importance to prevent thoſe accidental puffs of ſmoke which are ſometimes thrown into rooms by the careleſſneſs of ſervants in putting on ſuddenly too many coals at once upon the fire, and as I found theſe accidents ſometimes happened when the throats of Chimnies were made very narrow, I found that, upon the whole, all circumſtances being well conſidered, and advantages and diſadvantages compared and balanced, *four inches* is the beſt width that can be given to the throat of a Chimney; and this, whether the Fire-place be deſtined to burn wood, coals, turf, or any other fuel commonly uſed for heating rooms by an open fire.

In Fire-places deſtined for heating very large halls, and where very great fires are kept up, the throat of the Chimney may, if it ſhould be thought neceſſary, be made four inches and an half, or five inches wide;—but I have frequently made Fire-places for halls which have anſwered perfectly well where the throats of the Chimnies have not been wider than four inches.

It may perhaps appear extraordinary, upon the firſt view of the matter, that Fire-places of ſuch different ſizes ſhould all require the throat of the Chimney to be of the ſame width; but when it is conſidered that the *capacity* of the throat of a Chimney does not depend on its width alone, but on its width and *length* taken together; and that in large Fire-places, the width of the back, and conſequently the length of the throat of the Chimney, is greater than in thoſe which are ſmaller, this difficulty vaniſhes.

And this leads us to conſider another important point reſpecting open Fire-places, and that is, the width which it will, in each caſe, be proper to give to the back.---In Fire-places as they are now commonly conſtructed, the back is of equal width with the opening of the Fire-place in front;---but this conſtruction is faulty on two accounts.---Firſt, in a Fire-place ſo conſtructed, the ſides of the Fire-place, or *covings*, as they are called, are parallel to each other, and conſequently ill-contrived to throw out into the room the heat they receive from the fire in the form of rays;—and ſecondly, the large corners which are formed by making the back as wide as the opening of the Fire-place in front occaſion eddies of wind, which frequently diſturb the fire, and embarraſs the ſmoke in its aſcent in ſuch manner as often to bring it into the room.---Both theſe effects may be entirely remedied by diminiſhing the width of the back of the Fire-place.—The width which, in moſt caſes, it will be beſt to give it, is *one third* of the width of the opening of the Fire-place in front. ---But it is not abſolutely neceſſary to conform rigorouſly to this deciſion, nor will it always be poſſible. --It will frequently happen that the back of a Chimney muſt be made wider than, according to the rule here given, it ought to be. ---This may be, either to accommodate the Fire-place to a ſtove, which being already on hand, muſt, to avoid the expence of purchaſing a new one, be employed; or for other reaſons;--and any ſmall deviation from the general rule will be attended with no inconſiderable inconvenience.--It will always be beſt however to conform to it as far as circumſtances will allow.

Where a Chimney is deſigned for warming a room of a middling ſize, and where the thickneſs of the wall of the Chimney in front, meaſured from the front of the mantle to the breaſt of the Chimney, is nine inches, I ſhould ſet off four inches more for the width of the throat of the Chimney, which, ſuppoſing the back of the Chimney to be built upright, as it always ought to be, will give thirteen inches for the depth of the Fire-place in front, to the back.---In this caſe, thirteen inches would be a good ſize for the width of the back; and three times thirteen, or thirty-nine inches, for the width of the opening of the Fire-place in front; and the angle made by the back of the Fire-place and the ſides of it, or covings, would be juſt 135 degrees, which is the beſt poſition they can have for throwing heat into the room.

But I will ſuppoſe that in altering ſuch Chimney it is found neceſſary, in order to accommodate the Fire-place to a grate or ſtove already on hand, to make the Fire-place ſixteen inches wide.---In that caſe, I ſhould merely increaſe the width of the back, to the dimenſions required, without altering the depth of the Chimney, or increaſing the width of the opening of the Chimney in front.---The covings, it is true, would be ſomewhat reduced in their width, by this alteration; and their poſition with reſpect to the plane of the back of the Chimney, would be a little changed; but theſe alterations would produce no bad effects of any conſiderable conſequence, and would be much leſs likely to injure the Fire-place, than an attempt to bring the proportions of its parts nearer to the ſtandard, by increaſing the depth of the Chimney, and the width of its opening in front ;---or than an attempt to preſerve the particular obliquity of the covings which is recommended as the beſt, (135 degrees), by increaſing the width of the opening of the Fire-place, without increaſing its depth.

In order to illuſtrate this ſubject more fully, we will ſuppoſe one caſe more.---We will ſuppoſe that in the Chimney which is to be altered, the width of the Fire-place in front is either wider or narrower than it ought to be, in order that the different parts of the Fire-place, after it is altered, may be of the proper dimenſions. In this caſe, I ſhould determine the depth of the Fire-place, and the width of the back of it, without any regard to the width of the opening of the Fire-place in front; and when this is done, if the opening of the Fire-place ſhould be only two or three inches too wide, that is to ſay, only two or three inches wider than is neceſſary in order that the covings may be brought into their proper poſition with reſpect to the back, I ſhould not alter the width of this opening, but ſhould accommodate the covings to this width, by increaſing their breadth, and increaſing the angle they make with the back of the Fire-place ;---but if the opening of the Fire-place ſhould be more than three inches too wide ; ---I ſhould reduce it to the proper width by ſlips of ſtone, or by bricks and mortar. When the width of the opening of the Fire-place, in front, is very great compared with the depth of the Fire-place, and with the width of the back, the covings in that caſe being very wide, and conſequently very oblique, and the Fire-place very ſhallow, any ſudden motion of the air in front of the Fire-place, (that motion for inſtance which would be occaſioned by the clothes of a woman paſſing haſtily before the fire, and very near it,) would be apt to cauſe eddies in the air *within the opening of the Fire-place*, by which puffs of ſmoke might eaſily be brought into the room.

Should the opening of the Chimney be too narrow, which, however, will very ſeldom be found to be the caſe, it will, in general, be adviſable to let it remain as it is, and to accommodate the covings to it, rather than to attempt to increaſe its width, which would be attended with a good deal of trouble, and probably a conſiderable expence.

From all that has been ſaid it is evident, that the points of the greateſt importance, and which ought moſt particularly to be attended to, in altering Fire-places upon the principles here recommended, are, the bringing forward the back to its proper place, and making it of a proper width. But it is time that I ſhould mention another matter upon which it is probable that my reader is already impatient to receive information.--Proviſion muſt be made for the paſſage of the Chimney-ſweeper up the Chimney.---This may eaſily be done in the following manner:---In building up the new back of the Fire-place; when this wall, (which need never be more than the width of a ſingle brick in thickneſs,) is brought up ſo high that there remains no more than about ten or eleven inches between what is then the top of it, and the inſide of the mantle, or lower extremity of the breaſt of the Chimney, an opening, or door-way, eleven or twelve inches wide, muſt be begun in the middle of the back, and continued quite to the top of it, which, according to the height to which it will commonly be neceſſary to carry up the back, will make the opening about twelve or fourteen inches high; which will be quite ſufficient to allow the Chimney-ſweeper to paſs. When the Fire-place is finiſhed, this door-way is to be cloſed by a few bricks, by a tile, or a fit piece of ſtone, placed in it, dry, or without mortar, and confined in its place by means of a rabbet made for that purpoſe in the brick work. As often as the Chimney is ſwept, the Chimney-ſweeper takes down this temporary wall, which is very eaſily done, and when he has finiſhed his work, he puts it again into its place. The annexed drawing (No. 6.) will give a clear idea of the contrivance; and the experience I have had of it has proved that it anſwers perfectly well the purpoſe for which it is deſigned.

I obſerved above that the new back which it will always be found neceſſary to build in order to bring the fire ſufficiently forward, in altering a Chimney conſtructed on the common principles, need never be thicker than the width of a common brick. I may ſay the ſame of the thickneſs neceſſary to be given to the new ſides, or covings, of the Chimney; or if the new back and covings are conſtructed of ſtone, one inch and three quarters, or two inches in thickneſs will be ſufficient.--- Care ſhould be taken in building up theſe new walls to unite the back to the covings in a ſolid manner.

Whether the new back and covings are conſtructed of ſtone, or built of bricks, the ſpace between them, and the old back and covings of the

Chimney ought to be filled up, to give greater ſolidity to the ſtructure.---This may be done with looſe rubbiſh, or pieces of broken bricks, or ſtones, provided the work be ſtrengthened by a few layers or courſes of bricks laid in mortar; but it will be indiſpenſably neceſſary to finiſh the work where theſe new walls end, that is to ſay, at the top of the throat of the Chimney, where it ends abruptly in the open canal of the Chimney by a horizontal courſe of bricks well ſecured with mortar. ---This courſe of bricks will be upon a level with the top of the door-way left for the Chimney-ſweeper.

From theſe deſcriptions it is clear that where the throat of the Chimney has an end, that is to ſay, where it enters into the lower part of the open canal of the Chimney, *there* the three walls which form the two covings and the back of the Fire-place all end abruptly.---It is of much importance that they ſhould end in this manner; for were they to be ſloped outward and raiſed in ſuch a manner as to ſwell out the upper extremity of the throat of the Chimney in the form of a trumpet, and increaſe it by degrees to the ſize of the canal of the Chimney, this manner of uniting the lower extremity of the canal of the Chimney with the throat, would tend to aſſiſt the winds which may attempt to blow down the Chimney, in forcing their way through the throat, and throwing the ſmoke backwards into the room; but when the throat of the Chimney ends abruptly, and the ends of the new walls form a flat horizontal ſurface, it will be much more difficult for any wind from above to find, and force its way, through the narrow paſſage of the throat of the Chimney.

As the two walls which form the new covings of the Chimney are not parallel to each other; but inclined, preſenting an oblique ſurface towards the front of the Chimney, and as they are built perfectly upright, and quite flat, from the hearth to the top of the throat, where they end, it is evident that an horizontal ſection of the throat will not be an oblong ſquare; but its deviation from that form is a matter of no conſequence; and no attempts ſhould ever be made, by twiſting the covings above, where they approach the breaſt of the Chimney, to bring it to that form.---All twiſts, bends, prominences, excavations, and other irregularities of form, in the covings of a Chimney, never fail to produce eddies in the current of air which is continually paſſing into, and through an open Fire-place in which a fire is burning;---and all ſuch eddies diſturb, either the fire, or the aſcending current of ſmoke, or both; and not unfrequently cauſe the ſmoke to be thrown back into the room.---Hence it appears, that the covings of Chimnies ſhould never be made circular, or in the form of any other curve; but always quite flat.

For the ſame reaſon, that is to ſay, to prevent eddies, the breaſt of the Chimney, which forms that ſide of the throat that is in front, or neareſt to the room, ſhould be neatly cleaned off, and its ſurface made quite regular and ſmooth.

This may eaſily be done by covering it with a coat of plaſter, which may be made thicker or thinner in different parts as may be neceſſary in order to bring the breaſt of the Chimney to be of the proper form.

With regard to the form of the breaſt of a Chimney, this is a matter of very great importance, and which ought always to be particularly attended to.---The worſt form it can have is that of a vertical plane, or upright flat;---and next to this the worſt form is an inclined plane.---Both theſe forms cauſe the current of warm air from the room, which will, in ſpite of every precaution, ſometimes find its way into the Chimney, to croſs upon the current of ſmoke, which riſes from the fire, in a manner moſt likely to embarraſs it in its aſcent, and drive it back.---The inclined plane which is formed by a flat regiſter placed in the throat of a Chimney produces the ſame effects; and this is one reaſon, among many others, which have induced me to diſapprove of regiſter ſtoves.

The current of air, which, paſſing under the mantle, gets into the Chimney, ſhould be made *gradually to mend its courſe upwards*, by which means it will unite *quietly* with the aſcending current of ſmoke, and will be leſs likely to check it, or force it back into the room.---Now this may be effected with the greateſt eaſe and certainty, merely by *rounding off* the breaſt of the Chimney or back part of the mantle, inſtead of leaving it flat, or full of holes and corners; and this of courſe ought always to be done.

I have hitherto given no preciſe directions in regard to the height to which the new back and covings ought to be carried:---This will depend, not only on the height of the mantle, but alſo, and more eſpecially, on the height of the breaſt of the Chimney, or of that part of the Chimney where the breaſt ends and the upright canal begins.---The back and covings muſt riſe a few inches, five or ſix for inſtance, higher than this part, otherwiſe the throat of the Chimney will not be properly formed;---but I know of no advantages that would be gained by carrying them up ſtill higher.

I mentioned above, that the ſpace between the walls which form the new back and covings, and the old back and ſides of the Fire-place, ſhould be filled up ;---but this muſt not be underſtood to apply to the ſpace between the wall of dry bricks, or the tile which cloſes the paſſage for the Chimney-ſweeper, and the old back of the Chimney ; for that ſpace muſt be left void, otherwiſe, though this tile, which at moſt will not be more than two inches in thickneſs, were taken away, there would not be room ſufficient for him to paſs.

In forming this door-way, the beſt method of proceeding is to place the tile or flat piece of ſtone deſtined for cloſing it, in its proper place ; and to build round it, or rather by the ſides of it ; taking care not to bring any mortar near it, in order that it may be eaſily removed when the door-way is finiſhed.---With regard to the rabbet which ſhould be made in the door-way to receive it and fix it more firmly in its place, this may either be formed at the ſame time when the door-way is built, or it may be made after it is finiſhed, by attaching to its bottom and ſides, with ſtrong mortar, pieces of thin roof tiles. Such as are about an inch in thickneſs will be beſt for this uſe ; if they are thicker, they will diminiſh too much the opening of the door-way, and will likewiſe be more liable to be torn away by the Chimney-ſweeper in paſſing up and down the Chimney.

It will hardly be neceſſary for me to add, that the tile, or flat ſtone, or wall of dry bricks which is uſed for cloſing up this door-way muſt be of ſufficient height to reach quite up to a level with the top of the walls which form the new back and covings of the Chimnies.

I ought perhaps to apologize for having been ſo very particular in theſe deſcriptions and explanations, but it muſt be remembered that this chapter is written principally for the information of thoſe who, having had few opportunities of employing their attention in abſtruſe philoſophical reſearches, are not ſufficiently practiſed in theſe intricate inveſtigations, to ſeize, with facility, new ideas;---and conſequently, that I have frequently been obliged *to labour* to make myſelf underſtood.

I have only to expreſs my wiſhes that my reader may not be more *fatigued* with this labour than I have been;---for we ſhall then moſt certainly be ſatisfied with each other.---But to return once more to the charge.

There is one important circumſtance reſpecting Chimney Fire-places, deſtined for burning coals, which ſtill remains to be farther examined;---and that is the Grate.

Although there are few grates that may not be uſed in Chimnies conſtructed or altered upon the principles here recommended, yet they are not, by any means, all equally well adapted for that purpoſe.---Thoſe whoſe conſtruction is the moſt ſimple, and which of courſe are the cheapeſt, are beyond compariſon the beſt, *on all accounts*.---Nothing being wanted in theſe Chimnies but merely a grate for containing the coals, and in which they will burn with a clear fire;---and all additional apparatus being, not only uſeleſs, but very pernicious, all complicated and expenſive grates ſhould be laid aſide, and ſuch as are more ſimple ſubſtituted in the room of them.---And in the choice of a grate, as in every thing elſe, *beauty* and *elegance* may eaſily be united with the *moſt perfect ſimplicity.* Indeed they are incompatible with every thing elſe.

In placing the grate, the thing principally to be attended to is, to make the back of it coincide with the back of the Fire-place;---but as many of the grates now in common uſe will be found to be too large, when the Fire-places are altered and improved, it will be neceſſary to diminiſh their capacities by filling them up at the back and ſides with pieces of fire-ſtone. When this is done, it is the front of the flat piece of fire-ſtone which is made to form a new back to the grate, which muſt be made to coincide with, and make part of the back of the Fire-place. But in diminiſhing the capacities of grates with pieces of fire-ſtone, care muſt be taken not to make them *too narrow.*

The proper* width for grates deſtined for rooms of a middling ſize will be from ſix to eight inches, and their lengths may be diminiſhed more or leſs, according as the room is heated with more or leſs difficulty, or as the weather is more or leſs ſevere. ---But where the width of a grate is not more than five inches, it will be very difficult to prevent the fire from going out.

It goes out for the ſame reaſon that a live coal from the grate that falls upon the hearth ſoon ceaſes to be red hot;---it is cooled by the ſurrounding cold air of the atmoſphere. The knowledge of the cauſe which produces this effect is important, as it indicates the means which may be uſed for preventing it.---But of this ſubject I ſhall treat more fully hereafter.

It frequently happens that the iron backs of grates are not vertical, or upright, but inclined back-

* i.e depth

backwards. When theſe grates are ſo much too wide as to render it neceſſary to fill them up behind with fire-ſtone, the inclination of the back will be of little conſequence; for by making the piece of ſtone with which the width of the grate is to be diminiſhed in the form of a wedge, or thicker above than below, the front of this ſtone, which in effect will become the back of the grate, may be made perfectly vertical; and the iron back of the grate being hid in the ſolid work of the back of the Fire-place, will produce no effect whatever; but if the grate be already ſo narrow as not to admit of any diminution of its width, in that caſe it will be beſt to take away the iron back of the grate intirely, and fixing the grate firmly in the brick-work, cauſe the back of the Fire-place to ſerve as a back to the grate. This I have very frequently done, and have always found it to anſwer perfectly well.

Where it is neceſſary that the fire in a grate ſhould be very ſmall, it will be beſt, in reducing the grate with fire-ſtone, to bring its cavity, deſtined for containing the fuel, to the form of one half of a hollow hemiſphere; the two ſemicircular openings being one above, to receive the coals, and the other in front, or towards the bars of the grate; for when the coals are burnt in ſuch a confined ſpace, and ſurrounded on all ſides, except in the front and above, by fire-ſtone, (a ſubſtance peculiarly well adapted for confining heat,) the heat of the fire will be concentrated, and the cold air of the atmoſphere being kept at a diſtance, a much ſmaller quantity of coals will burn, than could poſſibly be made to burn in a grate where they would be more expoſed to be cooled by the ſurrounding air, or to have their heat carried off by being in contact with iron, or with any other ſubſtance through which heat paſſes with greater facility than through fire-ſtone.

Being perſuaded that if the improvements in Chimney Fire-places here recommended ſhould be generally adopted, (which I cannot help flattering myſelf will be the caſe,) that it will become neceſſary to reduce, very conſiderably, the ſizes of grates, I was deſirous of ſhowing how this may, with the greateſt ſafety and facility, be done.

Where grates, which are deſigned for rooms of a middling ſize, are no longer than 14 or 15 inches, it will always be beſt, not merely to diminiſh their lengths, by filling them up at their two ends with fire-ſtone, but forming the back of the Chimney of a proper width, without paying any regard to the length of the grate, to carry the covings through the two ends of the grate in ſuch a manner as to conceal them, or at leaſt to conceal the back corners of them in the walls of the covings.

I cannot help flattering myſelf that the directions here given in regard to the alterations which it may be neceſſary to make in Fire-places, in order to introduce the improvements propoſed, will be found to be ſo perfectly plain and intelligible that no one who reads them will be at any loſs reſpecting the manner in which the work is to be performed;—but as order and arrangement tend much to facilitate all mechanical operations, I ſhall here give a few ſhort directions reſpecting the manner of *laying out the work*, which may be found uſeful, and particularly to gentlemen who may undertake to be their own

architects,

architects, in ordering and directing the alterations to be made for the improvement of their Fire-places.

Directions for laying out the Work.

If there be a grate in the Chimney which is to be altered, it will always be beſt to take it away; and when this is done, the rubbiſh muſt be removed, and the hearth ſwept perfectly clean.

Suppoſe the annexed figure No. 1. to repreſent the ground plan of ſuch a Fire-place; A B being the opening of it in front, A C and B D the two ſides or covings, and C D the back.

Figure 2. ſhews the elevation of this Fire-place.

Firſt draw a ſtrait line, with chalk, or with a lead pencil, upon the hearth, from one jamb to the other,---even with the front of the jambs. The dotted line A B, figure 3, may repreſent this line.

From the middle c of this line (A B) another line *c d*, is to be drawn perpendicular to it, acroſs the hearth, to the middle *d*, of the back of the Chimney.

A perſon muſt now ſtand upright in the Chimney, with his back to the back of the Chimney, and hold a plumb line to the middle of the upper part of the breaſt of the Chimney (*d*, fig. 5,) or where the canal of the Chimney begins to riſe perpendicularly;---taking care to place the line above in ſuch a manner that the plumb may fall on the line *c d*, drawn on the hearth from the middle of the opening of the Chimney in front to the middle of the back, and an aſſiſtant muſt mark the preciſe place *e*, on that line where the plumb falls.

This being done, and the perſon in the Chimney having quitted his ſtation, four inches are to be ſet off on the line *c d*, from *e*, towards *d*; and the point *f*, where theſe four inches end, (which muſt be marked with chalk, or with a pencil,) will ſhow how far the new back is to be brought forward.

Through *f*, draw the line *g h*, parallel to the line A B, and this line *g h* will ſhow the direction of the new back, or the ground line upon which it is to be built.

The line *c f* will ſhow the depth of the new Fire-place; and if it ſhould happen that *c f* is equal to about *one-third* of the line A B; and if the grate can be accommodated to the Fire-place inſtead of its being neceſſary to accommodate the Fire-place to the grate, in that caſe, half the length of the line *c f*, is to be ſet off from *f* on the line *g f h*, on one ſide to *k*, and on the other to *i*, and the line *i k* will ſhow the ground line of the fore part of the back of the Chimney.

In all caſes where the width of the opening of the Fire-place in front (A B) happens to be not greater, or not more than two or three inches greater than *three times* the width of the new back of the Chimney (*i k*), this opening may be left, and lines drawn from *i* to A, and from *k* to B, will ſhow the width and poſition of the front of the new covings;---but when the opening of the Fire-place in front is ſtill wider, it muſt be reduced; which is to be done in the following manner.

From *c*, the middle of the line A B, *c a* and *c b*, muſt be ſet off equal to the width of the back (*i k*), added to half its width (*f i*), and lines drawn from *i* to *a*, and from *k* to *b*, will ſhow the ground plan of the fronts of the new covings.

When this is done, nothing more will be neceſſary than to build up the back and covings; and if the Fire-place is deſigned for burning coals, to fix the grate in its proper place, according to the direction already given.---When the width of the Fire-place is reduced, the edges of the covings *a* A and *b* B are to make a finiſh with the front of the jambs.---And in general it will be beſt, not only for the ſake of the appearance of the Chimney, but for other reaſons alſo, to lower the height of the opening of the Fire-place, whenever its width in front is diminiſhed.

Fig. 4. ſhows a front view of the Chimney after it has been altered according to the directions here given.---By comparing it with fig. 2. (which ſhows a front view of the ſame Chimney before it was altered,) the manner in which the opening of the Fire-place in front is diminiſhed may be ſeen.---In fig. 4. the under part of the door-way by which the Chimney ſweeper gets up the Chimney is repreſented by white dotted lines. The door-way is repreſented cloſed.

I ſhall finiſh this chapter with ſome general obſervations relative to the ſubject under conſideration; with directions how to proceed where ſuch local circumſtances exiſt as render modifications of the general plan indiſpenſably neceſſary.

Whether a Chimney be deſigned for burning wood upon the hearth, or wood, or coals in a grate, the form of the Fire-place is, in my opinion, moſt perfect when *the width of the back* is equal to the *depth of the Fire-place*, and the opening of the Fire-place in front equal to *three times* the width of the back, or, which is the ſame thing, to *three times the depth of the Fire-place*.

But if the Chimney be deſigned for burning wood upon the hearth, upon hand irons, or dogs, as they are called, it will ſometimes be neceſſary to accommodate the width of the back to the length of the wood, and when this is the caſe, the covings muſt be accommodated to the width of the back, and the opening of the Chimney in front.

When the wall of the Chimney in front, meaſured from the upper part of the breaſt of the Chimney to the front of the mantle, is very thin, it may happen, and eſpecially in Chimnies deſigned for burning wood upon the hearth, or upon dogs, that the depth of the Chimney, determining according to the directions here given, may be too ſmall.

Thus, for example, ſuppoſing the wall of the Chimney in front, from the upper part of the breaſt of the Chimney to the front of the mantle, to be only four inches, which is ſometimes the caſe, particularly in rooms ſituated near the top of a houſe; in this caſe, if we take four inches for the width of the throat, this will give eight inches only for the depth of the Fire-place, which would be too little, even were coals to be burnt inſtead of wood.---In this caſe I ſhould increaſe the depth of the Fire-place at the hearth to 12 or 13 inches, and ſhould build the back perpendicular to the height of the top of the burning fuel, (whether it be wood burnt upon the hearth, or coals in a grate,) and then, ſloping the back by a gentle inclination forward, bring it to its proper place, that is to ſay, *perpendicularly under the back part of the throat of the Chimney*.---This ſlope, (which will bring the back forward four or five inches, or juſt as much as the depth of the Fire-place is encreaſed,) though it ought not to be too abrupt, yet it ought to be quite finiſhed at the height of eight or ten inches above the fire, otherwiſe it may perhaps cauſe the Chimney to ſmoke; but when it is very near the fire, the heat of the fire will enable the current of riſing ſmoke to overcome the obſtacle which this ſlope will oppoſe to its aſcent, which it could not do eaſily were the ſlope ſituated at a greater diſtance from the burning fuel*.

Fig.

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* Having been obliged to carry backward the Fire-place in the manner here deſcribed, in order to accommodate it to a Chimney whoſe walls in front were remarkably thin,—I was ſurpriſed to find upon lighting the fire that it appeared to give out more heat into the room than any Fire-place I had ever conſtructed.—This effect was quite unexpected; but the cauſe of it was too obvious not to be immediately diſcovered.—The flame riſing from the fire broke againſt the part of the back which ſloped forward over the fire, and this part of the back being ſoon very much heated, and in conſequence of its being very hot, (and when the fire burnt bright it was frequently quite red hot,) it threw off into the room a great deal of radiant heat.—It is not poſſible that this oblique ſurface (the ſlope of the back of the Fire-place) could have been heated red-hot *merely* by the radiant heat projected by the burning fuel, for other parts of the Fire-place nearer the fire, and better ſituated for receiving radiant heat, were never found to be ſo much heated;—and hence it appears that the combined heat in the current of ſmoke and hot vapour which riſes from an open fire *may be*, at leaſt *in part*, ſtopped in its paſſage up the Chimney, changed into radiant heat, and afterwards thrown into the room.—This opens a new and very intereſting field for experiments, and bids fair to lead to important improvements in the conſtruction of Fire-places. I have of late been much engaged in theſe inveſtigations, and am now actually employed daily in making a variety of experiments with grates and Fire-places, upon different conſtructions, in the room I inhabit in the Royal Hotel in Pall Mall;—and Mr. Hopkins, of Greek-ſtreet, Soho, Ironmonger to his Majeſty, and Mrs. Hempel, at her Pottery at Chelſea, are both at work in their different lines of buſineſs, under my direction, in the conſtruction of Fire-places upon a principle entirely new, and which, I flatter myſelf, will be found to be not only elegant and convenient, but very economical.—But as I mean ſoon to publiſh a particular account of theſe Fire-places,—with drawings, and ample directions for conſtructing them, I ſhall not enlarge farther on the ſubject in this place.—It may however not be amiſs juſt to mention here, that theſe new-invented Fire-places not being fixed to the walls of the Chimney, but merely ſet down upon the hearth, may be uſed in any open Chimney; and that Chimnies altered or conſtructed on the principles here recommended are particularly well adapted for receiving them.

The Public in general, and more particularly thoſe Tradeſmen and Manufacturers whom it may concern, are requeſted to obſerve, that as the Author does not intend to take out himſelf, or to ſuffer others to take out, any patent for any invention of his which may be of public utility, Fig. 7, 8, and 9, ſhow a plan, elevation and ſection of a Fire-place conſtructed or altered upon this principle.---The wall of the Chimney in front at *a*, fig. 9, being only four inches thick, four inches more added to it for the width of the throat would have left the depth of the Fire-place meaſured upon the hearth *b c* only eight inches, which would have been too little; ---a niche *c* and *e*, was therefore made in the new back of the Fire-place for receiving the grate, which niche was ſix inches deep in the center of it, below, 13 inches wide, (or equal in width to the grate,) and 23 inches high; finiſhing above with a ſemicircular arch, which, in its higheſt part, roſe ſeven inches above the upper part of the grate.---The door-way for the Chimney-ſweeper, which begins juſt above the top of the niche, may be ſeen diſtinctly in both the figures 8 and 9.---The ſpace marked *g*, fig. 9, behind this door-way, may either be filled with looſe bricks, or may be left void.---The manner in which the piece of ſtone, *f*, fig. 9, which is put under the mantle of the Chimney to reduce the height of the opening of the Fire-place, is rounded off on the inſide in order to give a fair run to the column of ſmoke in its aſcent through the throat of the Chimney, is clearly expreſſed in this figure.

The plan fig. 7, and elevation fig. 8, ſhow how much the width of the opening of the Fire-place in front is diminiſhed, and how the covings in the new Fire-place are formed.

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utility, all perſons are at full liberty to imitate them, and vend them, for their own emolument, when and where, and in any way they may think proper; and thoſe who may wiſh for any further information reſpecting any of theſe inventions or improvements will receive *(gratis)* all the information they can require by applying to the Author, who will take pleaſure in giving them every aſſiſtance in his power.

A perfect idea of the form and dimenſion of the Fire-place in its original ſtate, as alſo after its alteration, may be had by a careful inſpection of theſe figures.

I have added the drawing fig. 10, merely to ſhow how a fault, which I have found workmen in general whom I have employed in altering Fire-places are very apt to commit, is to be avoided. ---In Chimnies like that repreſented in this figure, where the jambs A and B project far into the room, and where the front edge of the marble ſlab *o*, which forms the coving, does not come ſo far forward as the front of the jambs, the workmen in conſtructing the new covings are very apt to place them,---not in the line *c* A, which they ought to do,---but in the line *c o*, which is a great fault.---The covings of a Chimney ſhould never range *behind* the front of the jambs, however thoſe jambs may project into the room; but it is not abſolutely neceſſary that the covings ſhould *make a finiſh* with the internal front corners of the jambs, or that they ſhould be continued from the back *c*, quite to the front of the jambs at A. ---They may finiſh in front at *a* and *b*, and ſmall corners A, *o*, *a*, may be left for placing the ſhovels, tongs, &c.

Were the new coving to range with the front edge of the old coving *o*, the obliquity of the new coving would commonly be too great;---or the angle *a c o* would exceed 135 degrees, *which it ſhould never do*,---or at leaſt never by more than a very few degrees.

No inconvenience of any importance will ariſe from making the obliquity of the covings *leſs* than what is here recommended; but many cannot fail to be produced by making it much greater;---and as I know from experience that workmen are very apt to do this, I have thought it neceſſary to warn them particularly againſt it.

Fig. 11, ſhows how the width and obliquity of the covings of a Chimney are to be accommodated to the width of the back, and to the opening in front and depth of the Fire-place, where the width of the opening of the Fire-place is leſs than three times the width of the new back.

As all thoſe who may be employed in altering Chimnies may not, perhaps, know how to ſet off an angle of any certain number of degrees,---or may not have at hand the inſtruments neceſſary for doing it,---I ſhall here ſhow how an inſtrument may be made which will be found to be very uſeful in laying out the work for the bricklayers.

Upon a board about 18 inches wide and four feet long, or upon the floor or a table, draw three equal ſquares A, B, C, fig. 12. of about 12 or 14 inches each ſide, placed in a ſtraight line, and touching each other.---From the back corner *c* of the center ſquare B, draw a diagonal line acroſs the ſquare A, to its outward front corner *f*, and the adjoining angle formed by the lines *d c* and *c f* will be equal to 135 degrees,---the angle which the plane of the back of a Chimney Fire-place ought to make with the plane of its covings.---And a bevel, *m n*, being made to this angle with thin ſlips of hard wood, this little inſtrument will be found to be very uſeful in marking out on the hearth, with chalk, the plans of the walls which are to form the covings of Fire-places.

As Chimnies which are apt to ſmoke will require the covings to be placed leſs obliquely in

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reſpect to the back than others which have not that defect, it would be convenient to be provided with ſeveral bevels;—three or four, for inſtance, forming different angles.—That already deſcribed which may be called No. 1. will meaſure the obliquity of the covings when the Fire-place can be made of the moſt perfect form;—another No. 2. may be made to a ſmaller angle, *d c e*,—and another No. 3. for Chimnies which are very apt to ſmoke at the ſtill ſmaller angle *d c i*.—Or a bevel may be ſo contrived, by means of a joint, and an arch, properly graduated, as to ſerve for all the different degrees of obliquity which it may ever be neceſſary to give to the covings of Fire-places.

Another point of much importance, and particularly in Chimnies which are apt to ſmoke, is to form the throat of the Chimney properly, by carrying up the back and covings to a proper height.

This, workmen are apt to neglect to do, probably on account of the difficulty they find in working where the opening of the canal of the Chimney is ſo much reduced.---But it is abſolutely neceſſary that theſe walls ſhould be carried up five or ſix inches at leaſt above the upper part of the breaſt of the Chimney, or to that point where the wall which forms the front of the throat begins to riſe perpendicularly.---If the workman has intelligence enough to avail himſelf of the opening which is formed in the back of the Fire-place to give a paſſage to the Chimney-ſweeper, he will find little difficulty in finiſhing his work in a proper manner.

In placing the plumb-line againſt the breaſt of the Chimney, in order to aſcertain how far the new back is to be brought forward, great care muſt be taken to place it at the very top of the breaſt, where the canal of the Chimney *begins to riſe perpendicularly*; otherwiſe, when the plumb-line is placed too low, or againſt the ſlope of the breaſt, when the new back comes to be raiſed to its proper height, the throat of the Chimney will be found to be too narrow.

Sometimes, and indeed very often, the top of the breaſt of a Chimney lies very high, or far above the fire, (ſee the figures 13 and 14, where *d* ſhews the top of the breaſt of the Chimney;) when this is the caſe it muſt be brought lower, otherwiſe the Chimney will be very apt to ſmoke.---So much has been ſaid in the Firſt Chapter of this Eſſay of the advantages to be derived from bringing the throat of a Chimney near to the burning fuel, that I do not think it neceſſary to enlarge on them in this place,---taking it for granted that the utility and neceſſity of that arrangement have already been made ſufficiently evident;---but a few directions for workmen, to ſhew them how the breaſt, (and conſequently the throat) of a Chimney can moſt readily be lowered, may not be ſuperfluous.

Where the too great height of the breaſt of a Chimney is owing to the great height of the mantle, (ſee fig. 13.) or, which is the ſame thing, of the opening of the Fire-place in front, which will commonly be found to be the caſe; the only remedy for the evil will be to bring down the mantle lower;---or rather, to make the opening of the Fire-place in front lower, by throwing acroſs the top of this opening, from one jamb to the other, and immediately under the mantle, a very flat arch;---a wall of bricks and mortar, ſup-

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ported on ſtraight bars of iron;---or a piece of ſtone (*h*, fig. 13.)—When this is done, the ſlope of the old throat of the Chimney, (or of the back ſide of the mantle,) is to be filled up with plaſter, ſo as to form one continued flat, vertical, or upright plane ſurface with the lower part of the wall of the canal of the Chimney, and a new breaſt is to be formed lower down, care being taken to round it off properly, and make it finiſh at the lower ſurface of the new wall built under the mantle;—which wall forms in fact a new mantle.

The annexed drawing fig. 13, which repreſents the ſection of a Chimney in which the breaſt has been lowered according to the method here deſcribed, will ſhow theſe various alterations in a clear and ſatisfactory manner. In this figure, as well as in moſt of the others in this Eſſay, the old walls are diſtinguiſhed from the new ones by the manner in which they are ſhaded;---the old walls being ſhaded by diagonal lines, and the new ones by vertical lines. The additions, which are formed of plaſter, are ſhaded by dots inſtead of lines.

Where the too great height of the breaſt of a Chimney is occaſioned, not by the height of the mantle, but by the too great width of the breaſt, in that caſe, (which, however, will ſeldom be found to occur,) this defect may be remedied by covering the lower part of the breaſt with a thick coating of plaſter, ſupported, if neceſſary, by nails or ſtuds driven into the wall which forms the breaſt, and properly rounded off at the lower part of the mantle.---See fig. 14.

CHAP. III.

Of the Cauſe of the Aſcent of Smoke.---Illuſtration of the Subject by familiar Compariſons and Experiments.---Of Chimnies which affect and cauſe each other to ſmoke.---Of Chimnies which ſmoke from Want of Air.---Of the Eddies of Wind which ſometimes blow down Chimnies, and cauſe them to ſmoke.

THOUGH it was my wiſh to avoid all abſtruſe philoſophical inveſtigations in this Eſſay, yet I feel that it is neceſſary to ſay a few words upon a ſubject generally conſidered as difficult to be explained, which is too intimately connected with the matter under conſideration to be paſſed over in ſilence.---A knowledge of the cauſe of the aſcent of Smoke being indiſpenſably neceſſary to thoſe who engage in the improvement of Fire-places, or who are deſirous of forming juſt ideas relative to the operations of fire, and the management of heat, I ſhall devote a few pages to the inveſtigation of that curious and intereſting ſubject.---And as many of thoſe who may derive advantage from theſe inquiries are not much accuſtomed to philoſophical diſquiſitions, and would not readily comprehend either the language or the diagrams commonly uſed by ſcientific writers to explain the phænomena in queſtion, I ſhall take pains to expreſs myſelf in the moſt familiar manner, and to uſe ſuch compariſons for illuſtration as may eaſily be underſtood.

If ſmall leaden bullets, or large gooſe ſhot, be mixed with peas, and the whole well ſhaken in a buſhel, the ſhot will ſeparate from the peas, and will take its place at the bottom of the buſhel; forcing, by its greater weight, the peas which are lighter, to move upwards, contrary to their natural tendency, and take their places above.

If water and linſeed oil, (which is lighter than water,) be mixed in a veſſel by ſhaking them together, upon ſuffering this mixture to remain quiet, the water will deſcend and occupy the bottom of the veſſel, and the oil, being forced out of its place by the greater preſſure downwards of the heavier liquid, will be obliged to riſe and ſwim on the ſurface of the water.

If a bottle containing linſeed oil be plunged in water with its mouth upwards, and open, the oil will aſcend out of the bottle, and paſſing upwards through the maſs of water, in a continued ſtream, will ſpread itſelf over its ſurface.

In like manner when two fluids of any kind, of different denſities, come into contact, or are mixed with each other, that which is the lighteſt will be forced upwards by that which is the heavieſt.

And as heat rarefies all bodies, fluids as well as ſolids, air as well as water, or mercury,---it follows, that two portions of the ſame fluid, at different temperatures, being brought into contact with each other, that portion which is the hotteſt being more rarefied, or ſpecifically *lighter* than that which is colder, muſt be forced upwards by this laſt.---And this is what always happens in fact.

When hot water and cold water are mixed, the hotteſt part of the mixture will be found to be at the ſurface above;---and when cold air is admitted into a warmed room, it will always be found to take its place at the bottom of the room, the warmer air being in part expelled, and in part forced upwards to the top of the room.

Both air and water being tranſparent and colourleſs fluids, their internal motions are not eaſily diſcovered by the ſight; and when theſe motions are very ſlow, they make no impreſſion whatever on any of our ſenſes, conſequently they cannot be detected by us without the aid of ſome mechanical contrivance:---But where we have reaſon to think that thoſe motions exiſt, means ſhould be ſought, and may often be found, for rendering them perceptible.

If a bottle containing hot water tinged with logwood, or any other colouring drug, be immerſed, with its mouth open, and upwards, into a deep glaſs jar filled with cold water, the aſcent of the hot water from the bottle through the maſs of cold water will be perfectly viſible through the glaſs.---Now nothing can be more evident than that both of theſe fluids are forced, or *puſhed*, and not *drawn* upwards.---Smoke is frequently ſaid to be drawn up the Chimney;---and that a Chimney draws well, or ill;--but theſe are careleſs expreſſions, and lead to very erroneous ideas reſpecting the cauſe of the aſcent of Smoke; and conſequently tend to prevent the progreſs of improvements in the management of fires.---The experiment juſt mentioned with the coloured water is very ſtriking and beautiful, and it is well calculated to give a juſt idea of the cauſe of the aſcent of Smoke. The cold water in the jar, which, in conſequence of its ſuperior weight or denſity, forces the heated and rarefied water in the bottle to give place to it, and to move upwards out of its way, may repreſent the cold air of the atmoſphere, while the riſing column of coloured water will repreſent the column of Smoke which aſcends from a fire.

If Smoke required a Chimney to *draw* it upwards, how happens it that Smoke riſes from a fire which is made in the open air, where there is no Chimney?

If a tube, open at both ends, and of ſuch a length that its upper end be below the ſurface of the cold water in the jar, be held vertically over the mouth of the bottle which contains the hot coloured water, the hot water will riſe up through it, juſt as Smoke riſes in a Chimney.

If the tube be previouſly heated before it is plunged into the cold water, the aſcent of the hot coloured water will be facilitated and accelerated; in like manner as Smoke is known to riſe with greater facility in a Chimney which is hot, than in one in which no fire has been made for a long time.---But in neither of theſe caſes can it, with any propriety be ſaid, that the hot water is *drawn* up the tube.---The hotter the water in the bottle is, and the colder that in the jar, the greater will be the velocity with which the hot water will be forced up through the tube; and the ſame holds of the aſcent of hot Smoke in a Chimney.---When the fire is intenſe, and the weather very cold, the aſcent of the ſmoke is very rapid; and under ſuch circumſtances Chimnies ſeldom ſmoke.

As the cold water of the jar immediately ſurrounding the bottle which contains the hot water, will be heated by the bottle, while the other parts of the water in the jar will remain cold, this water ſo heated, becoming ſpecifically lighter than that which ſurrounds it, will be forced upwards, and if it finds its way into the tube will riſe up through it with the coloured hot water.---The warmed air of a room heated by an open Chimney Fire-place has always a tendency to riſe, (if I may uſe that inaccurate expreſſion,) and finding its way into the Chimney frequently goes off with the Smoke.

What has been ſaid, will, I flatter myſelf, be ſufficient to explain and illuſtrate, in a clear and ſatisfactory manner, the cauſe of the aſcent of Smoke; and juſt ideas upon that ſubject are abſolutely neceſſary in order to judge, with certainty, of the merit of any ſcheme propoſed for the improvement of Fire-places; or to take effectual meaſures, in all caſes, for curing ſmoking Chimnies.---For though the perpetual changes and alterations which are produced by accident, whim and caprice, do ſometimes lead to uſeful diſcoveries, yet the progreſs of improvement under ſuch guidance muſt be exceedingly ſlow, fluctuating and uncertain.

As to the cauſes of the ſmoking of Chimnies, they are very numerous and various; but as a general idea of them may be acquired from what has already been ſaid upon that ſubject in various parts of this Eſſay, and as they may, in all caſes (a very few only excepted,) be completely remedied by making the alterations in Fire-places here pointed out; I do not think it neceſſary to enumerate them all in this place, or to enter into thoſe long details and inveſtigations which would be required to ſhow the preciſe manner in which each of them operates, either alone, or in conjunction with others.

There is, however, one cauſe of ſmoking Chimnies which I think it is neceſſary to mention more particularly.---In modern built houſes, where the doors and windows are generally made to cloſe with ſuch accuracy that no crevice is left for the paſſage of the air from without, the Chimnies in rooms adjoining to each other, or connected by cloſe paſſages, are frequently found to affect each other, and this is eaſy to be accounted for.---When there is a fire burning in one of the Chimnies, as the air neceſſary to ſupply the current up the Chimney where the fire burns, cannot be had in ſufficient quantities from without, through the very ſmall crevices of the doors and windows, the air in the room becomes rarefied, not by heat, but by ſubtraction of that portion of air which is employed in keeping up the fire, or ſupporting the combuſtion of the fuel, and in conſequence of this rarefaction, its elaſticity is diminiſhed, and being at laſt overcome by the preſſure of the external air of the atmoſphere, this external air ruſhes into the room by the only paſſage left for it, namely, by the open Chimney of the neighbouring room: ---And the flow of air into the Fire-place, and up the Chimney where the fire is burning being conſtant, this expence of air is ſupplied by a continued current down the other Chimney.

If an attempt be made to light fires in both Chimnies at the ſame time it will be found to be very difficult to get the fires to burn, and both the rooms will be filled with ſmoke.

One of the fires,---that which is made in the Chimney where the conſtruction of the Fire-place is beſt adapted to facilitate the aſcent of the ſmoke,---or if both Fire-places are on the ſame conſtruction,—that which has the wind moſt favourable, or in which the fire happens to be ſooneſt kindled,—will overcome the other, and cauſe its ſmoke to be beat back into the room by the cold air which deſcends through the Chimney, ---The moſt obvious remedy in this caſe is to provide for the ſupply of freſh air neceſſary for keeping up the fires, by opening a paſſage for the external air into the room by a ſhorter road than down one of the Chimnies; and when this is done, both Chimnies will be found to be effectually cured.

But Chimnies ſo circumſtanced may very frequently be prevented from ſmoking even without opening any new paſſage for the external air, merely by diminiſhing the draught, (as it is called,) up the Chimnies; which can beſt be done by altering both Fire-places upon the principles recommended and fully explained in the foregoing Chapters of this Eſſay.

Should the doors and windows of a room be cloſed with ſo much nicety as to leave no crevices by which a ſupply of air can enter ſufficient for maintaining the fire, *after the current of air up the Chimney has been diminiſhed as much as poſſible by diminiſhing the throat of the Fire-place*; in that caſe there would be no other way of preventing the Chimney from ſmoking but by opening a paſſage for the admiſſion of freſh air from without;---but this, I believe, will very ſeldom be found to be the caſe.

A caſe more frequently to be met with is where currents of air ſet down Chimnies in conſequence of a diminution and rarefaction of the air in a room, occaſioned by the doors of the room opening into paſſages or courts where the air is rarefied by the action of ſome particular winds. In ſuch caſes the evil may be remedied, either by cauſing the doors in queſtion to cloſe more accurately,---or, (which will be ſtill more effectual,) by giving a ſupply of air to the paſſage or court which wants it, by ſome other way.

Where the top of a Chimney is commanded by high buildings, by clifts, or by high grounds, it will frequently happen, in windy weather, that the eddies formed in the atmoſphere by theſe obſtacles will blow down the Chimney, and beat down the ſmoke into the room.---This it is true will be much leſs likely to happen when the throat of the Chimney is contracted and properly formed than when it is left quite open, and the Fire-place badly conſtructed; but as it is *poſſible* that a Chimney may be ſo much expoſed to thoſe eddies in very high winds as to be made to ſmoke ſometimes when the wind blows with violence from a certain quarter, it is neceſſary to ſhow how the effects of thoſe eddies may be prevented.

Various mechanical contrivances have been imagined for preventing the wind from blowing down Chimnies, and many of them have been found to be uſeful;---there are, however, many of theſe inventions, which, though they prevent the wind from blowing down the Chimney, are ſo ill-contrived on other accounts as to obſtruct the aſcent of the Smoke, and do more harm than good.

Of this deſcription are all thoſe Chimney-pots with flat horizontal plates or roofs placed upon ſupporters juſt above the opening of the pot;---and moſt of the caps which turn with the wind are not much better.---One of the moſt ſimple contrivances that can be made uſe of, and which in moſt caſes will be found to anſwer the purpoſe intended as well or better than more complicated machinery, is to cover the top of the Chimney with a hollow truncated pyramid, or cone, the diameter of which above, or opening for the paſſage of the Smoke, is about 10 or 11 inches.---This pyramid, or cone, (for either will anſwer,)---ſhould be of earthen ware, or of caſt iron;---its perpendicular height may be equal to the diameter of its opening above, and the diameter of its opening below equal to three times its height.---It ſhould be placed upon the top of the Chimney, and it may be contrived ſo as to make a handſome finiſh to the brick-work. ---Where ſeveral flews come out near each other, or in the ſame ſtack of Chimnies, the form of a pyramid will be better than that of a cone for theſe covers.

The intention of this contrivance is, that the winds and eddies which ſtrike againſt the oblique ſurface of theſe covers may be reflected upwards inſtead of blowing down the Chimney.---The invention is by no means new, but it has not hitherto been often put in practice.---As often as I have ſeen it tried it has been found to be of uſe; I cannot ſay, however, that I was ever obliged to have recourſe to it, or to any ſimilar contrivance; and if I forbear to enlarge upon the ſubject of theſe inventions, it is becauſe I am perſuaded that when Chimnies are properly conſtructed *in the neighbourhood of the Fire-place*, little more will be neceſſary to be done at the top of the Chimney than to leave it open.

I cannot conclude this Eſſay without again recommending, in the ſtrongeſt manner, a careful attention to the management of fires in open Chimnies, for not only the quantity of heat produced in the combuſtion of fuel depends much on the manner in which the fire is managed, but even of the heat actually generated a very ſmall part only will be ſaved, or uſefully employed, when the fire is made in a careleſs and ſlovenly manner.

In lighting a coal fire more wood ſhould be employed than is commonly uſed, and fewer coals; and as ſoon as the fire burns bright, and the coals are well lighted, and *not before*, more coals ſhould be added to increaſe the fire to its proper ſize*.

The

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* *Kindling balls* compoſed of equal parts of coal,—charcoal—and clay, the two former reduced to a fine powder, well mixed and kneaded together with the clay moiſtened with water, and then formed into balls of the ſize of hen's eggs, and thoroughly dried, might be uſed with great advantage inſtead of wood for kindling fires. Theſe *kindling balls* may be made ſo inflammable as to take fire in an inſtant and with the ſmalleſt ſpark, by dipping them in a ſtrong ſolution of nitre and then drying them again, and they would neither be expenſive nor liable to be ſpoiled by long keeping. Perhaps a quantity of pure charcoal reduced to a very fine powder and mixed with the ſolution of nitre in which they are dipped, would render them ſtill more inflammable.

I have often wondered that no attempts ſhould have been made to improve the fires which are made in the open Chimnies of elegant apartments, by preparing the fuel; for nothing ſurely was ever more dirty, inelegant and diſguſting than a common coal fire.

Fire balls of the ſize of gooſe eggs, compoſed of coal and charcoal in powder, mixed up with a due proportion of wet clay, and well dried, would make a much more cleanly, and in all reſpects a pleaſanter fire than can be made with crude coals; and I believe would not be more expenſive fuel. In Flanders and in ſeveral parts of Germany, and particularly in the Dutchies of Juliers and Bergen, where coals are uſed as fuel, the coals are always prepared before they are uſed, by pounding them to a powder, and mixing them up with an equal weight of clay, and a ſufficient quantity of water to form the whole into a maſs which is kneaded together and formed into cakes; which cakes are afterwards well dried and kept in a dry place for uſe. And it has been found by long experience that the expence attending this preparation is amply repaid by the improvement of the fuel. The coals, thus mixed with clay, not only burn longer, but give much more heat than when they are burnt in their crude ſtate.

It will doubtleſs appear extraordinary to thoſe who have not conſidered the ſubject with ſome attention, that the quantity of heat produced in the combuſtion of any given quantity of coals ſhould be increaſed by mixing the coals with clay, which is certainly an incombuſtible body;—but the phenomenon may, I think, be explained in a ſatisfactory manner.

The enormous waſte of fuel in London may be eſtimated by the vaſt dark cloud which continually hangs over that great metropolis, and frequently overſhadows the whole country, far and wide; for this denſe cloud is certainly compoſed almoſt entirely of *unconſumed coal*, which having ſtolen wings from the innumerable fires of this great city has eſcaped by the Chimnies, and continues to ſail about in the air, till having loſt the heat which gave it volatility, it falls in a dry ſhower of extremely fine black duſt to the ground, obſcuring the atmoſphere in its deſcent, and frequently changing the brighteſt day into more than Egyptian darkneſs.

I never view from a diſtance, as I come into town, this black cloud which hangs over London without wiſhing to be able to compute the immenſe number of chaldrons of coals of which it is compoſed; for could this be aſcertained, I am perſuaded ſo ſtriking a fact would awaken the curioſity, and excite the aſtoniſhment of all ranks of the inhabitants; and *perhaps* turn their minds to an object of economy to which they have hitherto paid little attention.

The heat generated in the combuſtion of any ſmall particle of coal exiſting under two diſtinct forms, namely, in that which is *combined* with the flame and ſmoke which riſe from the fire, and which, if means are not found to ſtop it, goes off immediately by the Chimney and is loſt,—and the *radiant heat* which is ſent off from the fire in all directions in right lines:—I think it reaſonable to conclude, that the particles of clay which are ſurrounded on all ſides by the flame arreſt a part at leaſt of the combined heat, and prevent its eſcape; and this combined heat, ſo arreſted, heating the clay red hot, is retained in it, and being changed by this operation to radiant heat, is afterwards emitted, and may be directed and employed to uſeful purpoſes.

In compoſing *fire balls*, I think it probable that a certain proportion of chaff—of ſtraw cut very fine, or even of ſaw duſt, might be employed with great advantage. I wiſh thoſe who have leiſure would turn their thoughts to this ſubject, for I am perſuaded that very important improvements would reſult from a thorough inveſtigation of it.

Concluſion.

Though the ſaving of fuel which will reſult from the improvements in the forms of *Chimney Fire-places* here recommended will be very conſiderable, yet I hope to be able to ſhow in a future Eſſay, that ſtill greater ſavings may be made, and more important advantages derived from the introduction of improvements I ſhall propoſe in *Kitchen Fire-places.*

I hope likewiſe to be able to ſhow in an Eſſay on *Cottage Fire-places*, which I am now preparing for publication, that *three quarters*, at leaſt, of the fuel which cottagers now conſume in cooking their victuals, and in warming their dwellings, may with great eaſe, and without any expenſive apparatus, be ſaved.

THE END.

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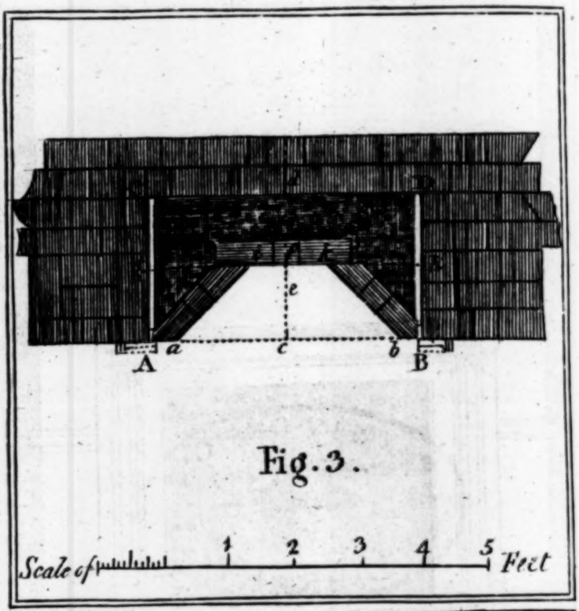

Fig. 3.

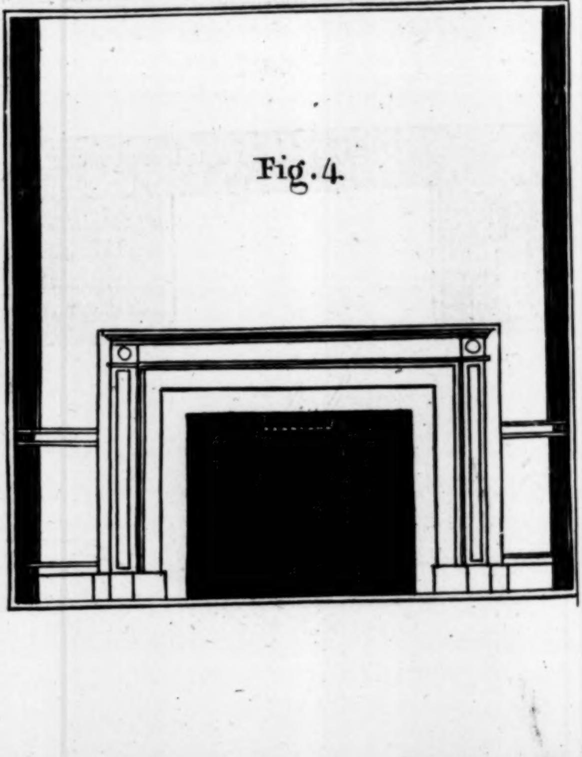

Fig. 4.

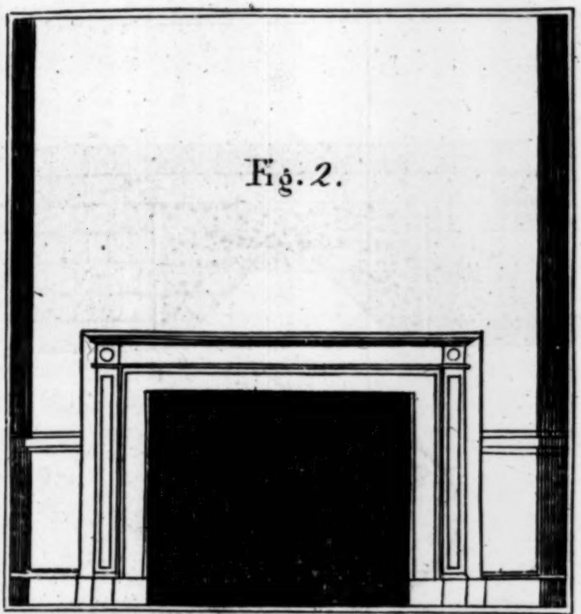

Fig. 2.

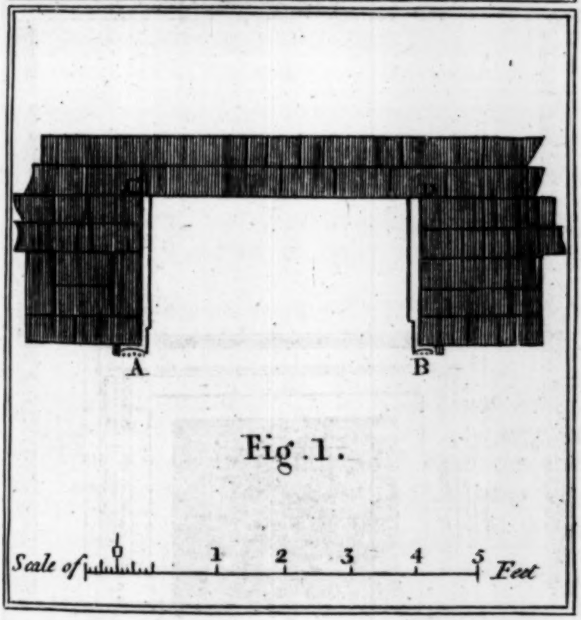

Fig. 1.

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EXPLANATION OF THE FIGURES.

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Fig. 1.

The plan of a Fire-place on the common conſtruction.

A B, the opening of the Fire-place in front.
C D, the back of the Fire-place.
A C and BD, the covings.
See page 42.

Fig. 2.

This figure ſhows the elevation, or front view of a Fire-place on the common conſtruction.
See page 42.

Fig. 3.

This Figure ſhows how the Fire-place repreſented by the Fig. 1. is to be altered in order to its being improved.

A B is the opening in front,—C D, the back, and A C and B D, the covings of the Fire-place in its original ſtate.

a b, its opening in front,—*i k*, its back,—and *a i* and *b k*, its covings after it has been altered, *e* is a point upon the hearth upon which a plum ſuſpended from the middle of the upper part of the breaſt of the Chimney falls. The ſituation for the new back is aſcertained by taking the line *e f* equal to four inches. The new back and covings are repreſented as being of bricks;—and the ſpace between theſe and the old back and covings as being filled up with rubbiſh. See page 43.

Fig. 4.

This Figure repreſents the elevation or front view of the Fire-place Fig. 3. after it has been altered. The lower part of the door-way left for the Chimney-ſweeper is ſhown in this Figure by white dotted lines.
See page 44.

Fig. 5.

This Figure ſhows the ſection of a Chimney Fire-place and of a part of the canal of the Chimney, on the common conſtruction.

a b is the opening in front; *b c*, the depth of the Fire-place at the hearth; *d*, the breaſt of the Chimney.

d e, the throat of the Chimney, and *d f*, *g e*, a part of the open canal of the Chimney.

Fig. 6.

Shows a ſection of the ſame Chimney after it has been altered.

k l is the new back of the Fire-place; *l i*, the tile or ſtone which cloſes the door-way for the Chimney-ſweeper *d i*, the throat of the Chimney, narrowed to four inches; *a*, the mantle, and *h*, the new wall made under the mantle to diminiſh the height of the opening of the Fire-place in front.

N. B. Theſe two Figures are ſections of the ſame Chimney which is repreſented in each of the four preceding Figures.

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Fig. 5.

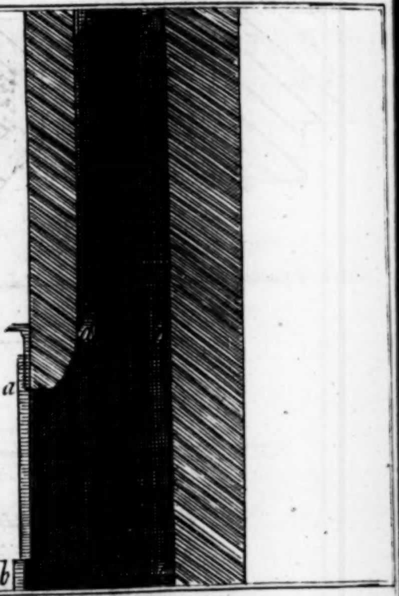


Fig. 6.

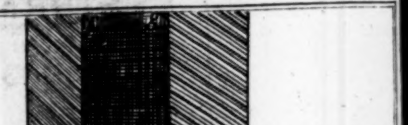


Fig. 7.

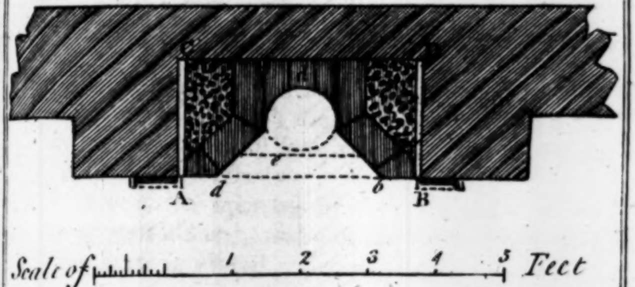
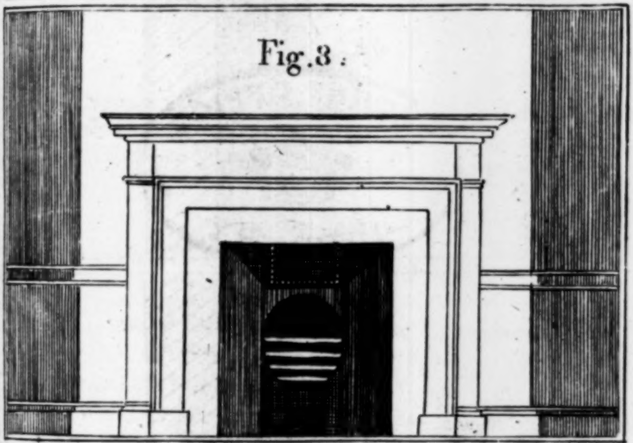


Fig. 8.



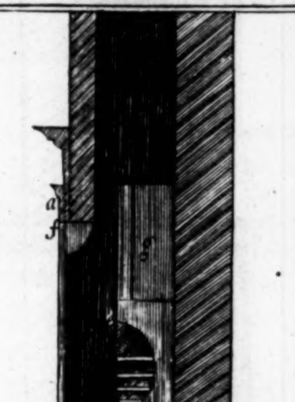


Fig. 9.

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Fig. 7.

This Figure repreſents the ground plan of a Chimney Fire-place in which the grate is placed in a nitch, and in which the original width A B of the Fire-place is conſiderably diminiſhed.

a b is the opening of the Fire-place in front after it has been altered, and *d* is the back of the nitch in which the grate is placed. See page 47.

Fig. 8.

Shows a front view of the ſame Fire-place after it has been altered; where may be ſeen the grate, and the door-way for the Chimney-ſweeper. See page 47.

Fig. 9.

Shows a ſection of the ſame Fire-place, *c d e* being a ſection of the nitch, *g* the door-way for the Chimney-ſweeper, cloſed by a piece of fire-ſtone, and *f* the new wall under the mantle by which the height of the opening of the Fire-place in front is diminiſhed. See page 47.

Fig. 10.

This Figure ſhews how the covings are to be placed when the front of the covings (*a* and *b*) do not come ſo far forward as the front of the opening of the Fire-place, or the jambs (A and B). See page 48.

Fig. 11.

This Figure ſhows how the width and obliquity of the covings are to be accommodated to the width of the back of a Fire-place, in caſes where it is neceſſary to make the back very wide. See page 49.

Fig. 12.

This Figure ſhows how an inſtrument called a bevel (*m n*), uſeful in laying out the work, in altering Chimney Fire-places, may be conſtructed. See page 49.

Fig. 13.

This ſhows how, when the breaſt of a Chimney (*d*) is too high, it may be brought down by means of a wall (*b*) placed under the mantle, and a coating of plaſter, which in this Figure is repreſented by the part marked by dots. See page 51.

Fig. 14.

This ſhows how the breaſt of a Chimney may be brought down merely by a coating of plaſter.
See page 51.

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Fig. 10.

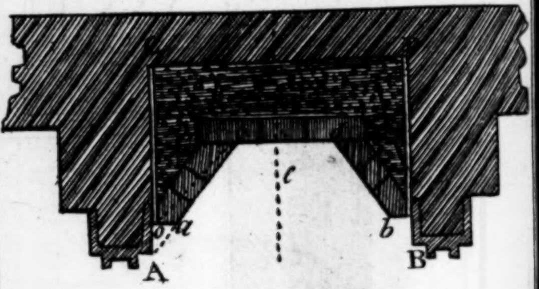


Fig. 11.

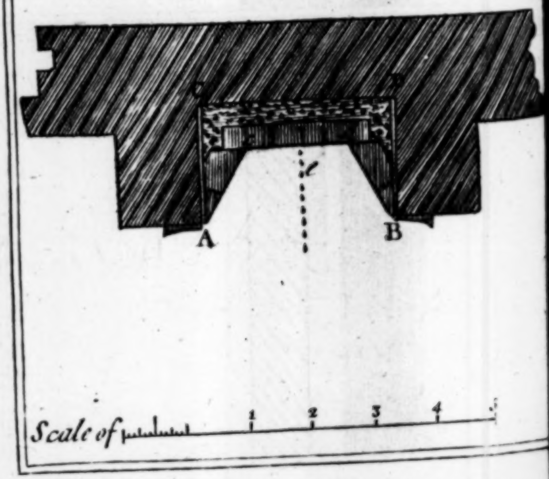
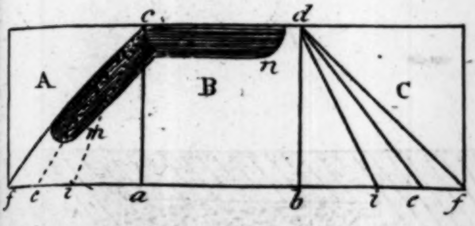


Fig. 12.



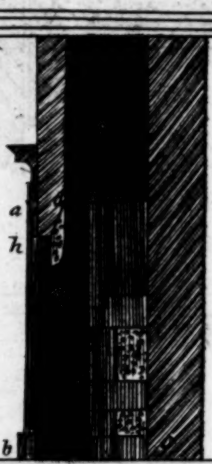


Fig. 13.

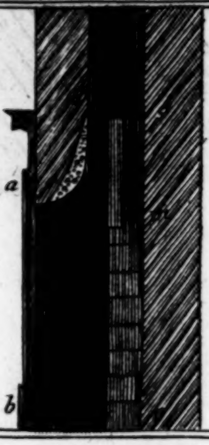


Fig. 14.

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